Source Control Summary for the Duwamish Diagonal Cleanup Project Addendum

Elliott Bay/Duwamish Restoration Program

Prepared for the
Elliott Bay/Duwamish Restoration Program Panel
by the
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FOR DUWAMISH/DIAGONAL SEDIMENT CLEANUP PROJECT
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1. INTRODUCTION

After the EBDRP Panel considered several alternatives, including a much broader area, the draft Duwamish/Diagonal Cleanup Study Report (December 2001) proposed a cleanup area of about 5-acres in size (actual size is 4.8 acres) immediately in front of the Duwamish CSO and Diagonal CSO/SD outfalls. The site was limited by available funds. However, during the public review process in February 2002, comments were received that recommended the site be expanded to remove an upstream area of high sediment chemistry called a chemical hot spot. The primary concern was that the 5-acre cleanup area would be recontaminated with PCBs exceeding the SQS when the chemical hot spot was dredged in the future. The Elliott Bay Duwamish Restoration Program (EBDRP) Panel had previously discussed the potential recontamination problem created by the upstream hot, but it appeared that the cost to address the upstream hot spot was beyond the available sediment remediation budget. In response to the concerns expressed about PCB recontamination and the lower cost estimates for the original project, the EBDRP Panel requested that an evaluation be conducted to determine if the upstream hot spot could be cleaned up using the remaining EBDRP sediment remediation funds. An expanded project was designed that removes the upstream hot spot and the cost of this expanded project was within the remaining EBDRP sediment remediation funds. Based on this new information, the EBDRP Panel is considering this expanded Duwamish/Diagonal cleanup project.

The Duwamish/Diagonal project schedule is very tight in an effort to begin construction of the cleanup action by November 2003 when the dredging window opens. Numerous permits are required before the project goes to construction and project staff cannot officially start the permitting process before the project is approved by Ecology. The Duwamish/Diagonal cleanup project was started in 1994 under the State Sediment Management Standards (SMS) process. Under this process, Ecology prepares a Cleanup Action Decision (CAD) document that issues Ecology's official determination of project approval.

Project staff met with Ecology and EPA staff to discussed the expanded project proposal and determine what information the regulatory agencies would need in order to consider the expanded project, and also allow the preparation of the CAD to proceed according to schedule. At the meeting it was determined that the regulatory agencies needed more information on the following three issues: 1) specific details about the expanded project; 2) documentation that source control had been addressed for the site; and 3) that the review comments for the Cleanup Study Report had been addressed appropriately. It was agreed that King County would produce three separate (stand-alone) products to provide information as soon as possible. These three products are the following:

1. The first document, titled Expanded Area For the Duwamish/Diagonal Cleanup Project, will provide details about the expanded project including reasons for expanding the project, the new project boundaries, justification for setting the boundaries, revised cost estimates, and methods for implementing the expanded project. The original 4.8-acre site was designated as cleanup Area A. To remove the upstream chemical hot spot, the project was expanded 2.1 acres and this part of the project was designated cleanup Area B. The dredge plan for the project is shown in Figure EX-1. Figure 2-4—Shoreline Features and Bathymetry shows the location of discharge pipes. Figure 5-9—Composite SQS/CSL Exceedance Areas shows sample stations with boundaries for Area A and Area B.
2. The second document, titled Source Control Summary, will provide a complete summary of the source control activities related to discharge pipes and other potential sources near the cleanup area. The following write up is the stand-alone document that provides the Source Control Summary
3. The third document, titled Responses to Reviewer Comments, will address all the comments received during the public review of the Cleanup Study Report in February 2002.

At some point in the future, all three of these documents will be attached to the finalized Cleanup Study Report as an expanded responsiveness summary. To expedited review of the expanded project, it was agreed that all three of these documents would be provided to Ecology and EPA prior to release of the finalized Cleanup Study Report. The schedule is for King County to provide these documents to Ecology and EPA the first part of April 2002, so work can proceed on finishing the CAD for public review in early March 2002.

2. OVERVIEW OF SOURCE CONTROL ACTIVITIES AND CONCLUSIONS

The general conclusion of the source control summary document was that many source control activities have occurred to reduce chemical inputs, which has eliminated concern about recontamination for most chemicals. There are a several discharge pipes that border the cleanup area, but only one is currently considered to be a significant source for recontamination. The Diagonal CSO/SD discharges about 1,230 MGY (million gallons per year) of separated storm water and less than 65 MGY of CSO (combined sewer overflow is mixed storm water and sewer water). The only two chemicals that are identified as a potential concern for recontamination are bis(2-ethylhexyl)phthalate and butyl benzyl phthalate, which are present in both separated storm water and CSO discharges. A brief overview of the main source control activities and conclusions is presented in this section and greater detail is provided in subsequent sections.

The Diagonal CSO/SD is one of two discharge pipes that are located along the inshore boarder of cleanup Area A and these discharges are located near the center of the border. The Diagonal CSO/SD discharge consists of a large concrete structure located in the intertidal area and attached to a buried 12-foot diameter pipe. A large amount of CSO control has occurred at Diagonal CSO/SD with the City of Seattle reducing CSO discharges to less than one event per year. King County has achieved about 80 percent

reduction in CSO volume at Diagonal CSO/SD with about 65 MGY remaining. The largest volume of discharge occurs from separated storm water from the Diagonal and Hanford basins and is estimated at 1,230 MGY. Sediment has settled in a long flat section of the pipe that is regularly filled with river water during high tide. The City of Seattle will conduct a pipe-cleaning project to remove the sediment and any associated contaminants before the Duwamish/Diagonal cleanup project is implemented. This will remove any historical contamination that may be left in the pipe and keep it from being flushed out onto the clean site. It will also allow new sediment accumulations to be assessed for ongoing source control activities.

The second outfall that boarders cleanup Area A is called the Duwamish CSO and this is a submerged outfall located about 100 feet upstream from the Diagonal CSO/SD. The Duwamish CSO is the emergency overflow for the Siphon and for the Duwamish Pump station, but this CSO is not expected to overflow unless there is an emergency situation that shuts down the pump station (i.e. power loss due to an earthquake). The Duwamish CSO has not overflowed since 1989 and is not considered a significant recontamination source.

There is also another outfall downstream of cleanup Area A. This SD outfall is off Nevada Street and drains a portion of the Port of Seattle T106 property that is used for warehousing and for a shipping container repair facility. It is several hundred yards downstream of Area A. There is an additional small, abandoned SD outfall on this property.

Cleanup Area B does not extend to the shoreline, but two discharge pipes are shown to be located inshore of the inshore cleanup boundary. The largest pipe is the historic outfall pipe from the old Diagonal Ave. treatment plant that operated from 1940 to 1969. This discharge pipe is exposed at low tide and is broken about 20 feet back from the outfall structure that appears to have settled. There has been no treatment plant discharge out this outfall for over 30 years, but a chemical hot spot is well defined in the sediment located offshore. In 1977, a dredging project was conducted by Chiyoda Corporation to create a mooring area and this dredging likely removed contaminated river sediment located down stream of the outfall. This project also dredged away the old shoreline, creating a new shoreline about 100 feet inshore of the old shoreline. Cleanup Area B extends upstream and down stream of the old treatment plant outfall and removes the entire chemical hot spot.

At the upstream end of cleanup Area B there is a small (12-inch) storm drainpipe located in the upper intertidal area. This small pipe is Diagonal Ave. South storm drain with a drainage basin of about 12 acres. Three sediment samples were collected offshore from this small SD pipe; however, the only chemicals that showed increased values near the storm drain were the two phthalates (butyl benzyl phthalate and bis (2-ethylhexyl) phthalate) that are present throughout Areas A and B. The lack of any elevated chemicals, besides phthalates, in these three sediment samples collected in front of the small SD outfall suggests there are no problem discharges to this small pipe that could be

a potential recontamination source to Area B. Also, the City and the regional hazardous waste program carry out periodic business inspections in this basin.

While the two outfall pipes that boarder cleanup Area B (historic treatment plant outfall and small Diagonal Ave. S. SD) are not considered to be a potential source of recontamination to the cleanup area, there exists other potential types of inputs from the neighboring property. Through the years, there were numerous activities at the old Diagonal Avenue sewage treatment plant property that could have introduced chemicals into the sediments. These activities include the use of sewage sludge drying ponds (1930-1969), dredge settling ponds for PCBs (1976) and filling with contaminated sediment dredged from near the old treatment plant outfall (1977). Consequently, regulatory agencies asked whether surface drainage, groundwater discharge, or bank erosion from the old treatment property could pose a potential source of recontamination to the Duwamish/Diagonal cleanup project.

After reviewing available information, project staff concluded that it appears unlikely that surface water, ground water, or bank erosion from the old treatment plant property would be a significant source recontamination to the Duwamish/Diagonal cleanup project. Most of the shoreline of the old treatment plant property is covered with rip rap rock to stabilize the bank. The one area that has exposed intertidal sediment was sampled and chemical analysis results showed low chemical concentrations. The row of sediment samples collected closest to shore near the old treatment plant property were low in most chemicals including PCBs. A large part of the old treatment plant property has been paved over (former Lafarge Cement site and T108 container storage), which will limit surface water contact with underlying sediment and prevent input from surface water. The Port of Seattle sampled groundwater at 14 wells drilled on the old treatment plant property in 1991/1992 (also called the Chiyoda/Chevron property) and the data do not indicate any problem chemicals in ground water.

There are three different programs that are applied to the entire Seattle area and reduce chemical inputs to CSO and SD discharges:

1. The City of Seattle runs a storm water protection program that involves business inspections and catch basin maintenance.
2. King County runs an industrial pretreatment program that is designed to limit chemical discharges to the sewer system in order to protect the sewage treatment plants from chemical upsets and to limit the amount of chemicals in biosolids.
3. A multi-agency hazardous waste program also inspects businesses to reduce the use of and promote the proper disposal of chemicals, which also significantly helps reduce chemical input into the drainage system.

In 1996 and 1997, the City conducted a focused business inspection in the Diagonal storm water drainage basin (Diagonal plus Hanford) as a source control action for the sediment cleanup project. Starting in late 2000 and continuing through 2001, the City of Seattle conducted additional business inspections in the storm water drainage basin. More inspections in this area are planned in the future through all three of the programs listed above.

All of the CSO control and BMP activities performed to date as well as ongoing activities reduce the chemical loading that will discharge out the Diagonal CSO/SD. This reduction can be seen in the core data in Section 5 of the Cleanup Study Report, where the older, deeper sediments have higher concentrations. The reduction of concentrations towards the surface demonstrates the reduction in loading being discharged. This reduction of loading is a direct measure of the success of source control activities to date.

Past experience monitoring sediments off CSO and SD discharges indicate that the only chemicals that produce sediment concentration above the SMS standards are the phthalates. The phthalates have wide spread usage in products and do not appear to be coming from localized point sources that could be controlled by industrial source control actions. Resource agencies seem to be in agreement that it is difficult to remove phthalates from large storm water discharges and that it is important to proceed with cleanup projects that remove high priority chemicals like PCBs even if there is potential for some level of phthalate recontamination. However, if ongoing source inspections identify significant sources, these will be investigated.

As part of the lower Duwamish River Superfund activities, Ecology has taken the lead to develop a comprehensive source control program that will protect sediments in the Duwamish River, including all sediment remediation sites. This comprehensive source control program will be developed during the next year and will apply to the Diagonal CSO/SD. Ongoing source control activities in the contributing basins will be consistent with and guided by this plan.

3. DISCHARGE PIPES AND ASSOCIATED SOURCE CONTROL ACTIONS

Prior to formation of the Municipality of Metropolitan Seattle (METO) in 1958 the City and other surrounding communities had small treatment plants that discharged to Lake Washington, Duwamish River, and Puget Sound. Pollution of Lake Washington resulted in the formation of METRO and the construction two new treatment plants at West Point (1964) and Renton (1962) to improve local water quality. To carry sewage flow to the West Point treatment plant, a large pipe called the Elliott Bay Interceptor (EBI) pipe was built along the east side of the Duwamish River and Elliott Bay. Three pump stations (PS) were required to move the flow in the EBI to the West Point treatment plant. The East Marginal PS is located furthest upriver, while the Duwamish PS is located near the Duwamish/Diagonal project. The Interbay PS was positioned at the downstream end of the EBI and is located on the north side of Elliott Bay. Sewage flow from West Seattle was required to travel east under the Duwamish River in a Siphon to reach the Duwamish PS where the sewage is then pumped north in the EBI. Two parallel siphon pipes (21-inch and 42-inch) are buried in the bottom of the Duwamish River and they pass under cleanup Area A.

The collection system designed for the West Point treatment plant contained relief points called combined sewer overflows (CSOs) to control the amount of combined sewage and

storm water that could enter the system and especially the EBI. This design was needed because a large part of the service area had a combined sewer system that carried both sewage and storm water in the same pipes, which resulted in very large flow volumes during rainstorms. Because it would be very difficult to collect and treat all the storm water with the sewage, the West Point treatment plant was built large enough to handle all of the sewage flow and up to twice this volume of storm water. During large storm events, the combined volume of sewage and storm water exceeded the capacity of the system and was addressed by having a series of relief points along the pipe. The CSO relief points only overflowed periodically during high flow periods. Regulator stations were built where the local sewage collection systems entered the EBI. During base flow all of the sewage flow from the local collection system was directed into the interceptor line, but when the volume increased greatly due to storm water, the excess flow from the local system was diverted to the receiving water as a CSO discharge.

Eventually it was recognized that the CSO discharges were pollutant sources that needed to be controlled. METRO instituted a formal CSO control program in 1979 under the impetus of the Federal Water Pollution Control Act Amendments of 1972. In 1987, Chapter 173-245 Washington Administrative Code (WAC) went into effect under the administration of Ecology, requiring reductions in CSO volumes to an average of one untreated discharge per year at each outfall. Chapter 173-245 WAC also requires CSO plans specifying the means of complying with the regulations.

METRO (now King County Department of Natural Resources and Parks -KCDNRP) developed an interim goal of achieving an overall reduction of 75 percent in CSO volume throughout the KCDNRP jurisdiction by the end of the year 2005. The first CSO control plan was prepare by METRO in 1988 and subsequently King County prepared 5-year update plans in 1995 and 2000. The current priority set for CSO control is to first address the outfalls that discharge in areas where there is the highest potential for human contact due to swimming or beach use. Because there is greater beach usage by humans near Puget Sound CSO sites, these areas were given higher priority to implement than the CSO sites in the Duwamish River. Consequently, the present schedule for completing CSO control projects in the Duwamish River are generally specified for years in the 2020's. This schedule applies to the remaining 65 MGY CSO coming out the Diagonal CSO/SD from King County.

The City also has CSO locations in the local collection system and these pipes discharge to the Duwamish River and Elliott Bay. The City has implemented a program to control CSO discharges and has almost achieved the required level of control in the Duwamish watershed (no more then one overflow event per year). It is important to point out that King County CSO volumes started out much larger than the City's CSO volumes, because the County assumed ownership of the large regulator stations that direct flows from the local collections systems into the large interceptor pipes like the EBI.

There are five discharge pipes that are relevant to the expanded sediment cleanup project and each will be discussed individually. The first two pipes boarder cleanup Area A and the second two pipes are inshore of cleanup Area B. The final pipe is downstream from

Area A. Only the Diagonal CSO/SD is considered to be a significant source to the cleanup area.

3.1. Diagonal CSO/SD Discharge

In 1966/1967 the City installed the large Diagonal storm drain line along the north boundary of the Diagonal Avenue treatment plant, which was in operation until 1969. The 12-foot diameter buried pipe ended at a large rectangular concrete outfall structure. The bottom of the outfall was set at an elevation of minus 3 feet (MLLW). There is no tide gate in the outfall so the long flat pipe regularly fills with Duwamish River water at high tide and at low tide empties accordingly. The Diagonal CSO/SD construction was part of a joint contract that METRO issued to build the Siphon across the Duwamish River and connect the Siphon to the Duwamish PS that was being built inshore to the east.

The Diagonal CSO/SD outfall receives primarily storm water and minor CSO flows from both the Diagonal and Hanford drainage basins. The volume of separated storm water discharged annually was estimated to be about 1,230 MGY when the drainage basin for Diagonal was assigned a value of 1,012 acres and the drainage basin for Hanford was assigned a value of 1,573 acres in the King County overflow model. The Diagonal CSO/SD is the City's largest storm water outfall handling runoff from a combined drainage area of about 2,585 acres (1,012 acres Diagonal plus 1,573 acres Hanford—see memo to Pat Romberg from Zhong Ji and drainage basin map) of residential, commercial, and about seven miles of I-5 freeway runoff. The 2001 draft Cleanup Study Report listed the combined drainage basin as 1,583 acres (Executive Summary, page ES-1 and section 3.2.1, on page 3-2); however, the combined drainage basin is actually 2,585 acres and this corrected value will be included when the Cleanup Study Report is finalized.

In addition to the separated storm water discharge, there is still a limited amount of CSO flow that is tributary to the Diagonal CSO/SD. There are a few local CSO points that can discharge into the storm water system. The City has completed over 90 percent CSO control in the Diagonal CSO/SD drainage basin and KCDNRP has achieved about 80 percent CSO control in the basin. The City collection system has 6 CSO locations that discharge into the Diagonal CSO/SD system from a drainage basin of about 620 acres. Five of the six City CSO locations were controlled by separation and storage to less than one overflow event per year. The one remaining CSO has a drainage basin of about 40 acres with a remaining CSO volume of about 0.5 MGY, but his site is scheduled for a CSO reduction project to be completed before 2004**.**

The KCDNRP collection system has 3 CSO locations that discharge into the Diagonal CSO/SD system and historically the CSO volume was estimated to be about 300 MGY. The CSO volumes from the KCDNRP discharges were reduced by about 80 percent by a past project, which leaves about 65 MGY remaining. The one CSO that is only partially controlled is the Hanford # 1 CSO, which is thought to have historically discharged as much as 300 MGY out the Diagonal CSO/SD. The flow is estimated based on old

reports that indicate the combined CSO volume for Hanford # 1 and # 2 together was as high as 600 MGY. It was also suggested that the flows were about equal, so the value of 300 MGY was used as the historic volume of Hanford # 1. The Hanford # 2 CSO discharges at a different location called the Hanford CSO, which is located further down river along the east side of the East Waterway.

The flow from Hanford # 1 was originally thought to result from only one combined sewer connection that was controlled in 1992. Later, 3 upstream connections were discovered: Bayview North; Bayview South; and Hanford at Rainer. There are now reported as Hanford # 1 and have control project scheduled to be completed in 2026. The method in which Hanford # 1 CSO overflows made it difficult for the model to accurately predict the overflow volume at that site. The model predicted a volume of 32 MGY, but due to the uncertainty in this prediction, the volume was doubled to 65 MGY, which is the volume reported in the draft 2001 Cleanup Study Report (Swarner, personal communication 1999). Further work is needed to accurately model the flow from the Hanford # 1 CSO.

In addition to the individual CSO control projects under taken by KCDNRP to reduce CSO flow, there was also a large system wide project implemented to reduce CSO overflows at all points in the collection system. This system was originally called the CATAD (Computer Augmented Treatment and Discharge) that uses pipe storage to reduce the volume of CSO flow that is discharged. A control system allows regulator gates to be kept closed a longer time, which stores CSO flow in the pipes until they are filled. This storage delays the time when the CSO starts and ultimately reduces the volume of CSO discharged. This system is being improved with more computer technology, which optimized the storage capacity over the entire system by using rain sensors to predict where in the KCDNRP system the CSO flows are likely to occur.

3.2. Duwamish CSO/Emergency Bypass

The Duwamish CSO outfall is a buried pipe located on the east side of the river. This outfall is the emergency relief point for the Siphon and the Duwamish PS. The Duwamish CSO does not overflow regularly like most true CSO discharge points. The last time this CSO overflowed was more then 11 years ago in 1989.

When the EBI was built in the mid 1960's, a series of emergency overflow pipes had to be installed at appropriate locations to protect the conveyance system from damage. Pipes need an emergency overflow because if the large volume of sewage flowing in the pipes were stopped immediately, the momentum of the flow would damage the pipe structures. The Siphon pipes that cross the river at Duwamish/Diagonal have an emergency overflow pipe at each end where the Siphon reaches the riverbank. At the east bank, the emergency overflow pipe is called the Duwamish CSO.

Pump stations need an emergency overflow to prevent flooding and damage to pumps. If there were an emergency shut down of the Duwamish PS, flow in the EBI must be diverted to protect the pump station facility and the interceptor line. In an emergency by-

pass situation, the flow upstream of the Duwamish PS would be diverted away from the pump station facility and out the Duwamish CSO pipe. The Duwamish PS is equipped with 3 very large sewage pumps plus an auxiliary power supply (engine generator unit) so there should be no need to by-pass out the Duwamish CSO except in an emergency beyond present back-up systems. The Duwamish Pump Station has a peak flow of 63 mgd and a maximum pumping capacity of 100 mgd (three pumping units). Also, under normal dry weather conditions (23 mgd), the station has two hours of storage time from shutdown to overflow. In addition, the Duwamish Pump Station is equipped with sensors for key operational conditions. Alarm signals are connected to telemetry sending alarm signals to West Division Main Control for continuous monitoring. Therefore, during normal conditions, it is unlikely that the pump station wet well will exceed a maximum set point because the station has been designed with enough reliability that overflow into the Duwamish River will not occur.

If an emergency by-pass were required out the Duwamish CSO, the chemical concentrations in the sewage or mixed sewage/storm water would hopefully be similar to the concentrations that are found regularly in either sewage or CSO samples that are routinely taken from the sewer collection system and treatment plants. Regular sampling of the influent of the Duwamish PS has been performed by KCDNRP's Industrial Waste Section, but not during storm periods. King County's Industrial Waste program is one of two local programs that are specifically designed to reduce the chemical levels in both the CSO and storm water discharges. These programs are discussed later in the next section of this document. These programs can also reduce the possibility that an earthquake will cause uncontrolled spills or discharge of pollutants to the receiving water.

The drainage basins that would contribute to an emergency by-pass out the Duwamish CSO have been identified and local programs that promote Best Management Practices (BMPs) for chemicals already serve these drainage basins. An emergency by-pass from the Siphon would involve combined sewage and storm water from the Delridge Trunk Sewer and the Chelan Avenue Regulator Station (both in West Seattle) that has a combined drainage basin of 1,169 acres. An emergency by-pass of the EBI (Elliott Bay Interceptor) flow to protect the Duwamish PS would involve all the flow coming down the EBI toward the Duwamish PS. The drainage basin for this by-pass would be all drainage basins upstream of the Duwamish PS. This EBI flow originates from two areas; 1) the East Marginal PS located upstream (drainage basin of 907 acres), plus 2) the flow from the local drainage located between the East Marginal PS and the Duwamish PS (local basin of 128 acres). Information regarding industrial and business inspection programs in these drainage basins is presented in a separate section of the Source Control Summary document (see Section 4).

3.3. Historic Diagonal Avenue Sewage Treatment Plant

The former Diagonal Avenue treatment plant was located near the river about 150 m to the south (upstream) of the Diagonal SD/CSO outfall. The treatment plant was built by the City and began operation in 1940. Plant capacity was 7 to 8 million gallons per day (MGD) of primary treatment with only a two-hour wastewater retention time (EBDRP

1994b). METRO was formed in 1958 to improve sewage treatment in the Seattle area, and took over operation of the plant in 1962. This plant was operational until 1969 when the final stage of the Elliott Bay Interceptor pipeline was completed and flows were diverted to the West Point treatment plant. The Diagonal Avenue treatment plant treated wastewater from Seattle's primary industrial core and was considered to be one of the most overloaded plants in the Seattle system (EBDRP 1 994b). Flow to the plant was limited by an upstream regulator that provided a bypass directly to the Duwamish River south of Slip 1 (Brown and Caldwell 1958). Due to the combined storm and sewer system, the plant frequently diverted untreated sewage into the Duwamish River during rain events (EBDRP 1994b). Treatment plant structures were removed in the mid-1970s, except for two below-ground clarifiers that were filled (AGI 1992). The sludge in the drying beds was covered with fill (AGI 1992) probably excavated from the near shore area when a berthing area was dredged in 1977.

A large portion of the contaminated sediment that may have been associated with the old treatment plant outfall appears to have been removed in 1977 when Chiyoda Corporation dredged a nearshore berthing area on the north side (downstream) of the old outfall. Chiyoda Corporation acquired the former treatment plant site in the mid-1970s. Little is known about Chiyoda Corporation's operations, except that it was a chemical company that wanted to develop a shore-based loading dock. They dredged the inshore area, but were unsuccessful at obtaining permits for the shore-based dock. Later, a mooring dock of piling clusters was built offshore.

In 1976, PCB-contaminated dredge spoils from a 1974 transformer fluid spill in Slip 1 (containing Aroclor 1242) were disposed on the Chiyoda property by the USACE. Two lagoons were excavated along the northern edge of the property in the former treatment plant for sludge beds to treat approximately 10 million gallons of PCB-contaminated sediment dredged from near Slip 1 (see aerial photo C-3, Appendix C of draft 2001 Cleanup Study Report). PCB-contaminated sediment was deposited primarily in the first receiving lagoon located closet to the river. Water pumped from the disposal lagoons was treated by particulate, sand, and charcoal filters prior to discharge to the Duwamish Waterway (AGI 1992). The PCB disposal pits were eventually back-filled with material from the excavation and additional sediment that Chiyoda dredged from the shoreline to improve berthing (AGI 1992).

The Port of Seattle acquired the Chiyoda property in 1980. The Port later sold part of the property to Chevron, retaining the portion along the river. Soil contaminated with petroleum hydrocarbons was stockpiled in the vicinity of the former disposal lagoons (AGI 1992). This soil was treated to meet the State of Washington TPH cleanup level of 200 mg/kg. The Port leased the southern part of the site to Lafarge Cement Company, which occupied the site from 1989-1998 and loaded cement barges at the mooring pile dock. This site is currently the Port of Seattle's Terminal 108 expansion area and is used for container storage.

3.4. Diagonal Avenue South Storm Drain

The Diagonal Avenue South SD is a small (12-inch) storm drainpipe located at the upstream end of cleanup Area B, but this pipe is located inshore in the upper intertidal area. This SD serves a relatively small drainage basin of about 12-acres that runs a short distance back from the river along Diagonal Avenue and is mostly paved. No effort was made to determine the volume of storm water that discharges out the Diagonal Ave. SD, because the volume would be small compared to the 1,200 MGY of storm water discharged out the Diagonal CSO/SD (located about 1,000 feet down stream). The 12-acre drainage basin for Diagonal Ave. South SD is about one-half of one percent (0.5 percent) of the 2,585-acre Diagonal CSO/SD drainage basin.

The only chemistry data reported for Diagonal Ave. South SD was a sediment sample collected from the pipe in 1985 for the Elliott Bay Action Program (Tetra Tech 1988). The data for the 1985 sediment sample was reported in the 1994 Duwamish/Diagonal Cleanup Study Plan and compared to state SMS values after normalizing appropriate chemicals for total organic carbon. This same data was reported in Appendix B of the 2001 draft Cleanup Study Report as Table 3-1. Three of the detected chemicals exceeded the SQS (zinc, indeno(1,2,3-c,d)pyrene, and di-n-octyl phthalate) and one exceeded the CSL value (chromium). This table also shows that 7 of the undetected chemicals were above the SMS values. Four of these seven chemicals exceeded the CSL values (1, 2-dichlorobenzene, 1,4-dichlorobenzene, hexachlorobenzene, and benzyl alxohol) and three exceeded the SQS values (1,2, 4-trichlorobenzene, butyl benzyl phthalate, and total PCBs). For these seven undetected chemicals, it is not possible to know whether the chemical concentrations were really above or below the SMS.

The sampling for the Duwamish/Diagonal cleanup study did not collect any sediment or water samples from the Diagonal Ave. South SD discharge pipe because sediment off shore from this pipe did not show any unusual chemical elevations. As part of the Duwamish/Diagonal site investigation, three sediment samples were collected offshore from the small SD pipe. The only chemicals that showed increased values near the storm drain were the two phthalates (butyl benzyl phthalate and bis(2-ethylhexyl)phthalate) that are present in Areas A and B. The lack of any elevated chemicals, besides phthalates, in these three sediment samples collected in front of the small SD outfall suggests there are no problem discharges to this small pipe that could be a potential recontamination source to Area B. Also, this small drainage basin would be subject to periodic business inspections carried out for other programs as discussed in the next section.

4. INDUSTRY AND BUSINESS INSPECTIONS FOR SOURCE CONTROL

Information regarding the types of industries and businesses in the drainage basins tributary to the CSO and SD discharges at the Duwamish/Diagonal sediment cleanup project was provided in Chapter 3 (Source Control Evaluation) of the 2001 draft Cleanup Study Report. However, it was pointed out this information was old because the source was a 1994 EBDRP report called the Cleanup Study Work Plan. A source control evaluation was conducted in 1994, when the Duwamish/Diagonal project started, because this was required as part of the SMS process. The project was sidelined for a few years

by EBDRP, meaning the initial source control work occurred a number of years before the expected cleanup. But it was understood that additional source control work would be conducted in the basin. Since that time, the City Stormwater Inspection Program, the Industrial Pretreatment Program and the Regional Hazardous Waste program have all carried out regular inspections in the drainage basin. All of these programs are described in more detail later in this section. These programs are designed to protect the landfills, the waste water treatment plants (including biosolids) and the local marine receiving waters of the Duwamish River and Elliott Bay. Because these programs are long term, they help fulfill the need for ongoing source control in the Diagonal CSO/SD drainage basins. Ecology is also preparing a comprehensive Source Control Plan for the lower Duwamish River Superfund area, which means that those source control objectives, requirements and implementation plans will apply to the Duwamish/Diagonal sediment cleanup site and drainage area.

4.1. City Storm Water Inspection Program

In 1996/1997 the City's Drainage and Waste Water Utility (DWU) undertook special source control investigations in the Diagonal CSO/SD basin in preparation for the Duwamish/Diagonal sediment cleanup project. The City began this work in 1995 and used standard industrial classification codes (SIC) to identify about 1,000 businesses, focusing on outdoor activities to minimize the presence of onsite pollutants that could come in contact with stormwater runoff. The majority of these businesses involved manufacturing, scrap yards, transportation, or automotive repair. Of these businesses, it was determined that more than 700 do not conduct outdoor activities that could potentially harm the environment (City of Seattle 1996). The remaining businesses were targeted for source control inspections. The names of these businesses are included in Appendix D of the Cleanup Study Report. The 264 business listed were to either received a drive-by inspection or an actual site visit inspection during 1996/1997. Also, a series of information bulletins were mailed to businesses. The objective was to control contamination input from upland basins by promoting best management practices, including disposal/storage activities and housekeeping practices, and to increase local awareness of the importance of protecting water quality.

The City has been conducting a second set of source inspections in the basin that will continue into 2003. In 2001, 200 businesses were inspected in the western portion of the Diagonal basin (109 drive-by inspections and 91 complete onsite inspections). A list of businesses inspected is provided in Table 1 and a map of the business locations is provided in Figure 1 attached to this Source Control Summary document. A total of 81 of the businesses inspected were not in compliance with City stormwater source control requirements. As shown in Figure 2 attached to this Source Control Document, most of the problems were related to inadequate maintenance of onsite storm drainage systems (33 percent) and inadequate spill response programs (47 percent). SPU inspectors worked with the business owners to improve their stormwater pollution prevention practices. As of March 2002, over 90 percent of the businesses inspected are now in compliance with City stormwater requirements.

Beginning in late 2000 and running through 2001, the City also conducted an intense business inspection program in the Diagonal CSO/SD basin trying to locate the source of a sticky white material that fouled fish nets on September 25, 2000. Samples of sticky material revealed it was a water-soluble acrylic resin that has a verity of uses including coatings for paper, textiles, and wood products, in adhesives, and in ion exchange resins. A number of businesses in the vicinity of the outfall were investigated, but no specific source of the resin material has yet been identified. The City prepared a brief summary of these activities in a memo attached to this Source Control Summary document.

The City inspections were initially conducted to identify possible sources of oil and resin materials, but also to evaluate storm water pollution prevention practices and to ensure that businesses were in compliance with the source control requirements of the City storm water, grading, and drainage control code (SMC 22,800). As of July 5, 2000, all businesses and residential properties are required to implement certain operational controls to reduce storm water pollution runoff (i.e., maintain onsite storm drain facilities, identify and eliminate illicit connections to the drainage systems, and maintain driveways, parking lots and sidewalks). In addition, businesses that engage in the following high-risk pollution generating activities are required to implement additional operational controls and must implement structural controls when applying for building permits after January 1, 2001: 1) Fueling operations; 2) Vehicle, equipment, and building washing and cleaning operations; 3) Truck or rail loading and unloading of liquid or solid materials; 4) Liquid storage in stationary above ground tanks; 5) Outside portable container storage of liquids, food wastes, or dangerous wastes; 6) Outside storage of non-containerized materials, by-products, or finished products; 7) Outside manufacturing activity; and 8) Landscape construction and maintenance. Business inspections focus on outdoor activities to minimize the presence of onsite pollutants that could come in contact with storm water runoff. Specific requirements for operational and structural controls are described in the City's 2000 Source Control Technical Requirements Manual.

During 2002 and 2003, the City surface water quality team will continue conducting source control activities in the Diagonal basin to support the early action cleanup proposed for the Duwamish/Diagonal CSO/SD as part of the lower Duwamish Superfund investigation. An additional inspector will be hired in 2002, who will be assigned primarily to the City Duwamish source control effort. Pollutant source inspections will be expanded to cover the eastern portion of the drainage basin that was not covered in 2001. In addition, focused inspections will be conducted at select businesses in the basin to determine whether these facilities are sources of the contaminants of concern (COC) found in the sediment offshore of the Diagonal outfall.

Another City program that reduces pollutant inputs from storm water is the program to clean street catch basins on a regular basis. Street dirt contains a great deal of chemical pollutants and a large percentage of the pollutants are attached to the dirt particles. Catch basins are designed to keep the street dirt from traveling into the storm drain pipe where the dirt will either accumulate and plug the pipe or be washed out to the receiving water. The main objective of the catch basin maintenance is to trap the street dirt before it enters the storm drain or sewer pipe. The catch basins tributary to the Duwamish/Diagonal

cleanup area will be cleaned regularly and this will reduce the input of contaminated street dirt in storm water discharges.

4.2. KC Industrial Waste Program

King County implements an Industrial Waste (IW) Program that started in 1969 and is consistent with the requirements of the Clean Water Act. The IW program requires nondomestic users of the metropolitan sewer system to pretreat wastewater before discharging it into the sewer system. Standards and limits are established to protect sewerage facilities and treatment processes, public health and safety, and the receiving waters. King County's IW rules and regulations require all industrial users to comply, at a minimum, with the applicable pretreatment standards and requirements of the Clean Water Act. In addition, the regulations require King County to establish discharge standards and limitations to the extent necessary to enable King County to comply with the NPDES. The IW program is funded by a combination of user charges and King County sewer fees and the 2000 budget was $1.48 million.

The IW program requires businesses to comply with federal, state, and local limits on pollutants. Regulated pollutants include heavy metals, flammable materials, sulfides, cyanide, organic compounds and laboratory chemicals. King County implements the pretreatment program through waste discharge permits and authorizations to industrial users. The program has resulted in a major decline of undesirable chemicals in wastewater received by King County treatment plants since the program began in 1969.

The IW program issues wastewater discharge permits and discharge authorizations to companies that have industrial processes with the potential to adversely affect King County treatment facilities. Permits are more comprehensive than discharge authorizations and generally require self-monitoring of the company's discharge. In addition to self-monitoring, King County staff inspects facilities with discharge permits and authorizations. Permits are issued to "Significant Industrial Users". Facilities below the threshold that require permits, can be issued discharge authorizations in the minor category (fewer requirements and no self-monitoring) or the major category (requires a limited amount of self-monitoring). At the end of 1999, King County had 145 Significant Industrial Users and 279 discharge authorizations.

In the past year, the IW program completed 210 inspections of Signficant Industrial Users and 77 inspections of facilities with discharge authorizations. Staff collected 2,628 compliance samples, primarily from Significant Industrial Users. In addition, companies reported that they had undertaken self-monitoring by performing 23,185 analyses of samples. When violations were identified, the IW program did follow-up inspections and sampling to verify that conditions causing the violations were corrected and eliminated. None of the violations identified by King County or by self-monitoring caused NPDES exceptions at King County treatment facilities (King County, 2000c).

In addition to monitoring discharges by businesses with discharge permits and authorizations, the Industrial Waste Program monitors pollutant levels at other locations throughout the wastewater collection system. Samples of wastewater influent are collected daily at the South Plant and the West Plant. Samples of wastewater are collected two weeks each year at several pump stations, siphons, interceptors, and key manholes (central points through which all wastewater from each sector of land flows). Each sampling station is monitored continuously for one week during the wet-weather season (November through April) and for one week during the dry-weather season (May through October). Heavy metal and other pollutant levels are measured and analyzed. The ongoing data collection allows staff to determine the range of pollutant concentrations over time. When heavy metals or other pollutants are detected at unusually high concentrations, staff often can determine the approximate direction from which a pollutant is coming, track the discharge to its source, and take corrective action.

All of these actions significantly lower the concentrations of pollutants in sewage and therefore in any CSO discharges that occur at the Diagonal CSO/SD. The King County IW program has some of the most stringent pretreatment requirements in the nation – significantly below EPA requirements. The ongoing tracking program will continue to identify violations or new sources or dumping. In the future the IW program will provide some additional support to source control investigations in the Diagonal CSO/SD drainage basin. One IW staff person will be assigned to work primarily in the Diagonal CSO/SD drainage basin during the last half of 2002 and in 2003.

4.3. Regional Hazardous Waste Program

The Regional Hazardous Waste Management Program complements King County's Industrial Waste Program by educating local residents and small businesses on ways to reduce hazardous waste and prevent water pollution. The program is a cooperative effort among King County DNRP (Solid Waste and Water & Land Resources Divisions), Public Health-Seattle and King County, City of Seattle Public Utilities, and 38 cities in King County and Snohomish County. This program implements the Local Hazardous Waste Management Plan adopted in 1990 by King County and all the local cities. The program is funded through fees added into commercial and residential garbage and sewer rates. The 2001 budget was $12.6 million. The program provides facilities for household and hazardous waste management and mobile collection and disposal operation.

The regional Hazardous Waste Management program targets industry groups and geographic areas to provide technical assistance. The staff make site visits to small businesses throughout King County and all of its incorporated cities and observe operating practices. When problem materials, such as lead, mercury, and solvent-based paints, are being disposed of in the sanitary sewer, staff counsel the company on correct practices. When necessary, staff can refer the matter to the Industrial Waste Program for regulatory action. In 2000, program staff inspected more than 3,000 businesses. Follow-up inspections indicate that 75 to 80 percent of businesses make at least one positive change in hazardous waste management or environmental practices as a result of the initial visit, and some businesses make numerous changes (Galvin, 2001). The Duwamish has been included in the geographic area coverage, meaning that every

business has been visited, in addition to targeted efforts for all auto body and repair shops, machine shops, photo labs and dry cleaners in the basin.

In addition to site visits, the program provides vouchers to qualified businesses to help defray the cost of hazardous waste management and equipment upgrading. Staff conduct household hazardous waste education through a telephone hotline, publications and public outreach. Also, staff respond to complaints about pollution incidents related to hazardous materials. Recent presentations were given to EPA and Ecology staff to inform them about the regional Hazardous Waste program and additional information can be provide upon request.

King County is currently sorting all the business inspections made by the regional hazardous waste program to determine how many were in the Diagonal CSO/SD drainage basin. This information will be assembled to provide documentation of businesses and activities. Also, this information will be coordinated with the inspection data from both the City business inspection work and the King County industrial waste inspection work. In 2002 and 2003, efforts will be made to focus revisits and to visit new businesses within the Diagonal CSO/SD drainage basin.

4.4. EPA Enforcement Action

The federal government has authorized EPA to regulate and enforce dangerous and hazardous waste through the Toxic Substances Control Act. The Elliott Bay Action Program that was conducted in the mid 1980's was a larger program funded by EPA to find and eliminate chemical discharges to Elliott Bay and the Duwamish River. Several volumes of reports were produced documenting chemical levels in bottom sediments and potential sources.

One example of where EPA took an enforcement action on a business in the Diagonal CSO/SD drainage basin was in 1984 when Janco-United received criminal charges and fines for discharging chemicals to the soil and storm sewer. Janco-United was a janitorial chemical supply company that formulated and repackaged a variety of commercial grade cleaners from concentrate. To avoid METRO's Industrial Pretreatment permitting process, the company installed an illegal drain-pipe in the summer of 1992 that lead to the Diagonal CSO/SD. For approximately every working day for 27 months, chemicals ranging from dilute rinsate to discontinued product were discharged by company employees down a storm sewer that was illegally connected to the Diagonal CSO/SD system. EPA found high concentrations of phthalates, chlorinated benzenes, and volatile organic compounds in soils and drains at the facility located at 4412 Fourth Avenue. Phthalates are two of the four chemicals that exceed SMS values at the Duwamish/Diagonal cleanup area as reported in the draft 2001 Cleanup Study Report.

4.5. CERCLA and MTCA Programs

The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCL), also known as Superfund, provide the national policy and procedures to

identify and cleanup contaminated sites on the National Priority List (NPL). The Lower Duwamish Waterway was placed on the NPL on September 13, 2001 and is now a Superfund site. The Lower Duwamish Waterway Group consisting of the Port of Seattle, the City of Seattle, Boeing, and King County are conducting a Remedial Investigation/Feasibility Study of the site. One aspect of the process is to identify early action projects where remediation can be undertaken in the near term while the rest of the sediment cleanup needs are established under the Superfund process. Source control requirements will apply to all early action projects.

The state of Washington has authority to regulate and enforce dangerous and hazardous waste through the Model Toxic Control Act (MTCA). Ecology is the lead for source control aspects at the lower Duwamish Superfund site. Ecology will develop a comprehensive Source Control Plan to protect sediment quality and sediment cleanup projects within the site that includes the Duwamish/Diagonal CSO/SD Cleanup project site. Provisions of this comprehensive plan will apply to the discharge pipes near the Duwamish/Diagonal sediment cleanup project, which includes the large Diagonal CSO/SD.

5. INVESTIGATION OF OIL SHEEN FROM DIAGONAL CSO/SD

5.1. Investigation

The City received reports of oil coming from the Diagonal CSO/SD and has investigated, but has not conclusively located the source of this oil discharge. The first oil sheen reported to the City and the U.S. Coast Guard and was on August 2, 1996. The City investigated by looking in manholes along the pipe to see if the input source could be located. The tide moved the oil sheen up and down the pipe so it was not possible to locate the source. None of the side branches checked along the lower 1.3 miles of the main storm drain showed any evidence of oil. A one page summary of this oil sheen investigation is dated February 7, 1997 and was included in Appendix B of the draft 2001 Cleanup Study Report.

The second documented oil sheen reported to the City and the U.S. Coast Guard was on November 8, 1999, when a large oil sheen extended from the outfall to the mouth of the river at Elliott Bay. On February 14, 2000, the City installed a temporary containment boom and absorbent boom offshore of the outfall. City staff checked the outfall daily, observing oil on a regular basis but at reduced levels. Inspections were dropped to weekly in 2001. The internal absorbent boom continues to be replaced as needed (about every2-3 months) and was last replaced on February 21, 2002.

While the source of the November 1999 spill has not been clearly identified, there were two possible sources of petroleum hydrocarbons found in the basin. In September 2000, Seattle Public Utilities crews removed about 6,500 gallons of oil-contaminated material from a storm drain at 7th Avenue S and S. Charlestown Street. Sediment blocked the line east of 7th Ave. S and during large storm events, this area could overflow to the Diagonal CSO/SD. Also, in July 2000, an oil sheen was observed in ground water and traced back

to a Union Pacific recovery operation that removed and estimated 38,000 gallons of diesel product. When active product recovery operations were initiated, the oil sheen at the Diagonal CSO/SD noticeably declined. However it was not possible to directly link the oil observed at the outfall with the diesel-contaminated groundwater.

5.2. Tie to 4-Methyl Phenol in River Sediments

Petroleum products contain 4-methyl phenol, which means that the presence of this compound in sediment could indicate the presence of oil products in sediments. The occurrence of 4-methyl phenol was seen to change over time in river sediments collected from Duwamish/Diagonal study area and could indicate a corresponding change in the input of sediments containing oil material. Site assessment sampling in 1994 and 1995 did not find any 4-methyl phenol in any sample, but the compound appeared in samples collected for the project in 1996. A few sediment samples have been taken from the area by other studies in 1997 and 1998 and 4-methyl phenol was present during both those years. The observation of 4-methyl phenol in samples from 1996 through 1998 corresponds to the August 1996 date that the oil sheen was observed from the Diagonal CSO/SD.

Surface sediment samples were collected for the Duwamish/Diagonal project in 1992, 1994, 1995, and 1996. Only the first and last years of sampling had 4-methyl phenol been present in measurable concentrations. In 1992, six preliminary samples were collected, but only two of these had detectable levels at 130 ug/kg dry weight (DW). In 1994, surface samples were collected from 35 stations and in 1995 surface samples were collected from 10 surface sample; however, 4-methyl phenol was not detected in any of these samples. In 1996, samples were collected at 10 surface stations and all but 3 samples were above the detection limit. The 7 samples above the detection limit had fairly high values. The 5 samples in front of the outfall (DUD200, DUD201 - DUD204) had values that ranged from 484 -769 ug/kg DW, with two of these (DUD200 and DUD204) were above the SQS/CSL value of 670 ug/kg DW. However, the highest samples were further upstream with a value of 1,350 ug/kg DW at Station DUD205 and a value of 4,630 ug/kg DW at Station DUD207. This station is located at about the middle of the loading pier, but offshore at the east channel line. In 1997, King County collected samples near the Duwamish/Diagonal study area for the Duwamish Water Quality Analysis and found 4-methyl phenol values that ranged from 168-427 ug/kg DW. In 1998, a Puget Sound Ambient Monitoring (PSAM) station (# 204) collected from the Duwamish/Diagonal study area was reported to exceed the SQS/CSL value of 670 ug/kg DW.

King County has found the presence of 4-methy phenol in sediment varies over time at the Pier 53-55 sediment cap along the Seattle waterfront, but speculated the source might be wood waste rather than oil. The 4.5 acre cap was placed in March 1992 and baseline samples showed low chemical values. The one year post-cap sampling (1993) revealed

that the entire cap surface had been recontaminated with high levels of PAHs due to a piling removal action at Coleman Ferry Dock, which boarders the cap. Despite high levels of PAHs, no 4-methyl phenol was detected. When the cap was sampled again in 1996, the PAHs levels were greatly reduced, but substantial levels of 4-methyl phenol were found at all 7 surface grab stations. The values ranged from 106 to 2,160 ug/kg DW and the highest value (VG5) exceeded the SQS/CSL. Four stations had values ranging from 423 - 574 ug/kg DW. These results prompted a special sampling event in 1998, which showed that 4-methyl phenol values were reduced to undetectable levels. The source of 4-methyl phenol was not located but there was some speculation that it could be related to wood waste. Also, it appeared that the presence of this compound might be seasonal, but this was not investigated.

The degredation rate of 4-methyl phenol is predicted to be rapid in aerobic conditions, but slower under anerobic conditions. In a freshwater lake, total degradation was shown to occur in only 6 days, while the half-life in marine waters was less than 4 days. In a study of anaerobic lake sediment, degradation did not begin during the 29 weeks of the study (Howard 1991). Studies show 4-methylphenol has a very low adsorb to soil/sediment (less than 1% in one study). Howard (1991) also mentioned that the highest levels and the most frequent detections of 4-methylphenol were in the effluent discharges from the timber products industry. One speculation was that 4-methylphenol on the Pier 53-55 cap might be associated with wood debris that could originate from three sources: 1) wood products that have been cast off from the piers throughout Seattle's history; 2) from the drift wood that accumulates along the waterfront; 3) from wood or wood products used in the construction and repair of the piers along the waterfront. Oil was not listed as suspected source of 4-methyl phenol along the waterfront.

Because the presence of 4-methy phenol in sediments at Duwamish/Diagonal cleanup area could indicate the presence of oil in the sediment to be dredged, Ecology wanted to know about contingency plans to address any oil released from the sediment during dredging activities. The design engineers for the project (Anchor Environmental) will address this issue as part of a complete quality assurance (QA) plan for the project that will be developed during design. One method to address potential oil releases from sediment during dredging that will be included in the QA plan is the use of an oil absorption boom. If the oil absorption boom were needed, the boom would likely be used to encircle the area being dredged. The oil absorption boom would be replaced as needed to minimize any oil plume on the river surface. If significant oil is observed in the water that accumulates on the haul-barge, then one method to remove this oil would be to place oil absorbent material overtop the filter fabric material used to filter water before the accumulated water leaves the haul-barge back into the river.

6. DIAGONAL CSO/SD PIPE CLEANING PLAN

Considerable sediment has settled in the long flat section of the Diagonal CSO/SD pipe. The City previously sampled this pipe in the 1980's, but in 1992 the City conducted a

pipe inspection and sampled accumulated sediments as part of the EBDRP project. It was agreed early in the project that the sediment would need to be cleaned from the pipe before the Duwamish/Diagonal sediment cleanup project was completed to avoid the potential of any contamination in those sediments recontaminating the cleanup project. The EBDRP project established a source control budget for various activities, and the Diagonal CSO/SD pipe cleaning was assigned a projected cost of $ 500,000.00. The City took the lead to design and implement a project. The City first determined how much sediment was present in the pipe and then identified methods for conducting the pipe cleaning. Part of this activity involved collection of new pipe sediment chemistry samples and this data will be discussed below along with the earlier data from 1992.

6.1. Pipe Cleaning

Investigations discovered that sediment was present in main discharge line and also in two tributary lines. The maximum depth of accumulated sediment was about 12 inches in the main and about 8 inches in one tributary line. The volume of sediment in the main line was estimated at about 434 cubic yards. The volume of sediment in one tributary line to be cleaned was estimated at about 64 cubic yards each. The total projected volume of sediment was about 498 cubic yards. It is assumed that this sediment will be taken to a landfill for disposal or to a soil-recycling contractor for treatment and re-use. One of three pipe cleaning methods found to be feasible will be used to clean the pipe, tentatively scheduled for the late summer dry season (August) of 2003.

6.2. Chemical Samples Of Diagonal Pipe Sediments

In 1994, as part of the Duwamish/Diagonal project, the City collected 4 pipe sediment samples from the Diagonal CSO/SD. This data was reported in Appendix G of the 2001 draft Cleanup Study Report along with a map showing the sampling locations (see 1994 Pipe Sediment Sampling Locations Map and Figure 5 for Diagonal Storm Drain Pipe Sediment Samples). This pipe sediment data was originally used to decide that the Diagonal CSO/SD pipe should be cleaned prior to performing the Duwamish/Diagonal sediment cleanup action. Information about the samples that the City collected from this pipe in the 1980's was not included in the draft 2001 Cleanup Study Report because the 1994 data was more recent. For source tracing activities, it is most useful to use the most current data, which means the samples collected in 2002 will provide more information than the 1994 pipe samples.

In January and February 2002, ll pipe sediment samples were collected and submitted for chemical analysis. The initial sampling plan was to collect sediment samples only from the mainline, but it was discovered that two tributary side lines had sediment accumulation. In late January 2002, pipe sediment samples were collected at 7 of the 8 planned locations in the mainline. In late February 2002, pipe sediment samples were collected at 4 of the 5 planned locations in the tributary lines. There was not enough sediment present to collect a sample at all planned location.

The chemical results will provide information to evaluate whether the pipe sediment can be disposed of at a landfill and compare pipe sediment concentration with those of surface sediments in the river in front of the outfall. The data is also useful for source tracing of high chemistry values that would indicate a problem discharge that should be controlled. The Data Report (dated March 28, 2002) was just received by project staff; consequently, there has not been time to perform any of the data analysis listed above. To insure Ecology and EPA have the data as soon as possible, a copy of the chemical data is attached and is labeled Table C-1 and C-3. Also attached is Table 2 that is a Summary of Constituents Exceeding Criteria by Sample Location. A few of the results written in the report are included in this Source Control Summary document and the entire pipe sampling report will soon be available.

Table C-1 shows that all samples collected from the main line had concentrations of total petroleum hydrocarbons that were less then the MTCA Method A soil cleanup levels for unrestricted use. However, 4 of the 5 samples from the two tributary lines exceeded the MTCA Method A cleanup level for total petroleum hydrocarbons (TPH) as motor oil. One tributary sediment sample (T-3a; Duwamish Ave South) exceeded the TPH criteria as diesel fuel. All metals except cadmium at the Duwamish Avenue South tributary line were less than the MTCA Method A soil cleanup level. Even though the inline sediment is above the MTCA criteria, the results show that sediment cleaned from the pipe is suitable for disposal as a solid waste or for recycling and re-use following treatment. When metals values are compared to the SMS criteria, only zinc exceeded the SQS value and this was in 3 of the 5 tributary samples.

Table C-3 reports organic chemistry data compared to SMS standards and Table 2 summarizes the constituents that exceed the SMS and the MTCA Soil Cleanup Levels for Unrestricted Uses. This table shows that concentrations of two or more PAH compounds in the three most down gradient main line sampling locations were greater than the SQS criteria. All sampling locations except one side tributary sample (T2) had concentrations of bis(2-ethyl hexyl)phthalate that were greater than the SQS chemical criteria. Three of the 5 tributary lines exceeded the SQS value for butyl benzyl phthalate, but no main line samples exceed SQS for this chemical. Two of the mainline and all of the tributary samples have concentrationsx of benzo(a)pyrene that were greater than MTCA Method A soil cleanup levels. (Tetra Tech Technical Memo dated March 27, 2002).

7.0 SAMPLES OF PIPE SEDIMENT AND PIPE WATER

This section provides a summary of the samples that have been collected to characterize pipe sediment and pipe water in the basin tributary to the Duwamish/Diagonal sediment cleanup project. Also, provided is information about a 1996/1997 King County study that conducted an extensive sampling program for CSOs that discharge to the Duwamish River.

7.1. Pipe Sediment Data

The previous section reported that 11 new pipe sediment samples were collected from the Diagonal CSO/SD during the first two months of 2002. As discussed above, the data for the 7 samples from the mainline and the 4 samples from the tributary lines are provided to EPA and Ecology as part of this Source Control Summary document (see Tables C-1 and C-3).

No sediment sampling is possible for the Duwamish CSO discharge. This CSO is actually the emergency by-pass for the Siphon and the Duwamish pump station, which has not overflowed for 11 years (since 1989). There is no location to collect a sediment sample from the Siphon and the continuous flow probably limits any accumulation of sediment in the Siphons. The only accumulated sediment in the Duwamish CSO pipe would probably be located near the end of the outfall pipe where river sediment can settle in the end of the discharge pipe.

The only other pipe discharging to the Duwamish/Diagonal cleanup area is the small (12-inch) Diagonal Ave. S. storm drain that is located near the upstream corner, but inshore of Cleanup Area B. The drainage basin is 12 acres and runs a short distance back from the river. In 1988, the Elliott Bay Action Program sampled pipe sediment, but the pipe has not been sampled since because the offshore sediments in front of the pipe did not show any unusual chemicals.

In 1994, King County collected three sediment samples from directly in front of the small outfall pipe (DUD013, DUD014, and DUD015) as part of the Duwamish/Diagonal site assessment. Sediment at these three stations looked like clean tan colored sand and the chemical values were low for all chemicals except the 2 phthalates butyl benzyl phthalate and bis(2-ethyl hexyl phthalate. Both of these phthalates have higher concentration downstream at the large Diagonal CSO/SD. These sediment sample data are evaluated in Section 7.3.

7.2. Pipe Effluent Samples

The CSO discharges to the Diagonal CSO/SD have not been sampled. However, King County has a lot of CSO data that can be used to characterize the estimated 65 MGY of CSO discharged to this basin. King County characterized CSOs under a requirement of the NPDES (National Pollution Discharge Elimination System) permit for West Point Treatment Plant. In addition, King County conducts special studies of CSO discharges at various times. The most recent study of CSO discharges to the Duwamish River was in 1996/1997 and resulted in a report titled King County Combined Sewer Overflow Water Quality Assessment for the Duwamish River and Elliott Bay (1988).
A major CSO sampling activity was conducted in 1996/1997 and involved the collection of over 100 samples that were analyzed for organic and metal pollutants.

The King County sampling activity in 1996/997 focussed on 4 CSO sites (Brandon St CSO, Chelan Avenue CSO, King St CSO, and Hanford St CSO also know as Hanford # 2 CSO). Appendix L of the CSO Study Report provided information on the dates that different CSOs were sampled, and a copy is attached to this Source Control Summary

document (see BIBLIOGRAPHY OF DATA REPORTS AND QUALITY ASSURANCE REVIEWS). The chemistry data for the 1996/1997 CSO sampling is contained in the King County database. The primary use of the 1996/1997 data was input to a mathematical model that predicted chemical concentration in the Duwamish River with and without CSO discharges. Spreadsheets were prepared in 2002 to inventory the CSO data available as potential input for new effluent modeling work and these inventory sheets are attached.

About 1,230 MGY of separated storm water is discharged out the Diagonal CSO/SD and King County conducted sampling in 1995 to characterize this storm water. It took two years to get 10 storm water samples because it is difficult to sample the lower part of this drainage basin. It is not possible to sample within the Diagonal CSO/SD or the lower part of the tributary lines because these areas flood with river water during high tide. During the first year the two planned sampling locations (Diagonal at Colorado and Diagonal at Airport Way S.) had to be abandoned due to backup water during high tide. The two pipes that King County was finally able to sample were located farther up the system (South Hinds at 8th Avenue and South Horton at 13th Street South).

The metal and phthalate data for these 10 samples were included in Appendix H (METRO Recontamination Modeling Report) of the draft 2001 Cleanup Study. A copy of this data table is attached to this Source Control Summary document (see table labeled Stormwater vs Model). In this table it shows the 3 samples from Hinds were pooled with the 7 samples from Horton to produce average values that are listed on the right side of the table. For comparison, the first column on this table provides the average CSO value that was derived for the 1996 model calculations. The CSO values are mostly higher than the average storm water value calculated from the 10 samples collected in 1995. It was recognized that the storm water data was limited with only 10 samples, so the model was run using the higher CSO average values instead of storm water data to insure conservative results.

The small (12-inch) Diagonal Avenue South storm drain has not been sampled for storm water. As stated above, the storm water from the Diagonal Avenue South SD was not considered to be a significant potential recontamination source to the Duwamish/Diagonal sediment cleanup project for three reasons: 1) The sediment offshore from the pipe did not show any high chemical levels, 2) The flow is expected to be low because the 12-acre drainage basin is only about one-half of one percent (0.5 percent) of the size of the 2,585-acre Diagonal CSO/SD drainage basin, 3) The small discharge pipe is located far inshore from the inshore boundary of Cleanup Area B. These CSO and stormwater sample data are evaluated in Section 7.3.

7.3. Comparison To SMS Or Water Quality Criteria

The 2002 pipe samples have been compared to the SMS values as shown in Tables C-1 and C-3. There were not many metals that exceeded standards. Zinc exceeded SQS in three of the 11 samples and chromium exceeded SQS in one sample. The two most down gradient samples from the main line had 4 -8 PAH compounds that exceeded the SQS

values. The next sample upstream had only two PAH compounds above the SQS. All sample locations except one (T2 from tributary) had bis(2-ethylhexyl)phthalate above the SQS and the highest value was in the main line sample second from the end (location of most PAHs). Three tributary lines exceeded the SQS for butyl benzyl phthalate (Duwamish Avenue South, Denver Avenue South, and 1st Avenue South). PCBs were detected in two tributary lines and one of these was 35.6 mg/kg OC, which is above the SQS.

The pipe data reflects accumulation over a long time so it may have limited value for tracking current sources. There is no way of knowing if the concentrations seen are from current from historical contamination. The pipe sediment will be removed, which takes away the potential that the existing pipe sediment could recontaminate the cleanup project. After the pipe is cleaned, the new sediment that accumulates would be more reflective of current sources. Those sediments will be sampled to look for ongoing sources. However, it may take some time before a significant amount of new sediment collects in the pipe. In the meantime, the surface of the cap will be routinely sampled to look for recontamination as part of the long-term monitoring plan.

King County does not typically compare the CSO water sample data directly to the Water Quality Criteria because the discharge dilutes when it enters the receiving water. Usually, the receiving water data is compared to the Water Quality Criteria. King County has measured receiving water quality and also has used models to predict the receiving water concentrations. As mentioned above, one part of the Duwamish Water Quality Study was to take all the CSO data and use it as input to the hydraulic river model that was able to calculated the chemical concentrations in the river water both with and without the CSO discharges. King County also collected at least 118 receiving water sample (see data Inventory Sheets attached) that were analyzed for metals and organic chemicals. Both the measured values and the calculated values of river water meet the Water Quality Standards.

Storm water will dilute when it enters the receiving water so again the comparison to Water Quality Criteria must be done with caution. The 10 storm water samples collected in 1995 from Diagonal CSO/SD were compared to calculated Water Quality values for metals. Two sets of Water Quality Criteria values were calculated because freshwater must be adjusted for hardness (see table attached to the storm water data—Water Quality Criteria (ug/L)[1]). Some metals, such as copper, lead, nickel, and zinc, exceed the Water Quality Criteria, but these values would meet the criteria values with a dilution factor of 10-20, which is a relatively small dilution. From the limited storm water data, it suggests that some metals are higher at Hinds because two of these three samples had the highest value for copper and zinc (samples from July 9, and November 8, 1995).

8. PHTHALATE RECONTAMINATION POTENTIAL

The two chemical groups of greatest interest for potential recontamination at Duwamish/Diagonal are phthalates and PCBs. These two chemicals have different

sources, which required two different focuses to modeling. The primary source of phthalates is from the storm water discharged out the Diagonal CSO/SD; consequently, phthalate recontamination modeling was tied to the discharge pipe. The source of PCB recontamination is not the present discharge pipes because based on even conservative assumptions of PCB levels in the discharge, the concentrations are too low to be a problem. The most likely PCB source would be future dredging of contaminated sediment. This issue requires a different model that will be discussed in a following section.

8.1. Recontamination Modeling

Sediment recontamination modeling of the Diagonal CSO/SD was conducted on three separate occasions, using two different methods, in attempts to characterize the likelihood of recontamination of the sediment in the Study Area following cleanup. The first modeling effort was undertaken in 1996 by KCDNR, using a modification of the SEDCAM model named METSED. This modeling had to be modified in 1997, when new information from the City significantly increased the assumed stormwater discharge for the Diagonal SD from an estimated annual flow of 685 MGY to 1230 MGY. The third modeling effort was conducted by WEST Consultants in 1999, using direct field observations, supplemented by analytical and numerical results, to perform a mass balance between the chemicals observed in the "footprint" and the various sources, including background.

In 1996/1997, KCDNR conducted sediment recontamination modeling to evaluate the likelihood of recontamination of the sediment at the site after sediment cleanup project was completed. The full modeling report, including the update information, was presented in Appendix H of the draft 2001 Cleanup Study Report and a summary was provided in Section 3.4.1 of that report. The conclusion of this modeling effort by KCDNR was that cleaned sediment in the vicinity of the Duwamish/Diagonal outfalls would likely be recontaminated above the SQS by bis (2-ethylhexyl) phthalate and butyl benzyl phthalate. This modeling approach was not totally consistent because it also predicted that two metals would pose a greater recontamination potential than the two phthalates. However, the measured surface sediment concentrations at the site showed that these two metals did not exceed the SMS values as was predicted by the model. This conclusion led to further modeling, using another approach, in an effort to confirm or refute these findings.

After a lot of discussion about modeling options, it was decided in 1999 to use a simple mass balance model. The full modeling report from West Consultants was presented in Appendix I and summarized in Section 3.4.2 of the draft 2001 Cleanup Study Report. A basic mass balance modeling approach was selected because it relies on the simplest assumptions and is based primarily on field observations, supplemented by numerical modeling results, to define the relationship between discharges from the storm drains and combined sewer overflows and the nearby sediment. This approach was used to determine the discharge load reduction necessary for each constituent to maintain sediment quality compliance in the Duwamish/Diagonal footprint following cleanup.

The results of this modeling effort indicate that chrysene, fluoranthene, pyrene, and 1,4-dichlorobenzene will not exceed the SQS after cleanup (i.e., recontamination is unlikely to occur). For butyl benzyl phthalate however, recontamination is indicated, even if discharge from the storm drain is completely eliminated. Virtually the same is true for bis (2-ethylhexyl) phthalate. Depending on the background concentration assumed for bis (2-ethylhexyl) phthalate, upwards of 87 percent of the source would have to be eliminated to maintain sediment concentrations below the SQS after cleanup. This result suggested that background levels of phthalates in the river are high enough that it would not take much additional input from a particular discharge to exceed the SQS at that location.

The report also identifies important limitations to this method imposed by the available data. Improved knowledge of settling rates near the discharges, chemistry of the discharges, and chemistry of the background sediment would greatly reduce the uncertainties present in the current analysis. However, simulation of the complex physical and chemical processes that create the "footprint" from the various discharges will remain difficult.

There presently is no model that can predict the recontamination that will result from the CSO and storm water discharges because these outfalls have complicated discharge conditions. Because of the need to have a mathematical model that can accurately sediment recontamination, King County started developing a new model in late 2001 that should better predict recontamination for such complicated discharge scenarios. This model will first be developed for CSO discharge, but will be applicable to storm water discharges. That model, when ready, will be applied to the Duwamish/Diagonal outfalls using the latest source data to improve the understanding of recontamination potential at the site and help target the direction of any source control activities.

8.2. Phthalate Toxicity

The toxicity of phthalates does not appear to be as great as suggested by the SMS criteria values because biological effects are not observed when the numeric SQS and CSL values are exceeded. Under the SMS rule, the potential for sediment to cause adverse biological effects is defined by chemical criteria. Biological testing is routinely used to confirm chemical designation of sediments (Ecology 1996). Three of the biological tests specified by the SMS rule were used in this study: The amphipod (ten-day) and echinoderm (21-day) bioassays were selected to identify acute effects based on mortality and effective mortality (combined mortality and abnormality) endpoints, respectively. The juvenile polychaete bioassay was selected to evaluate chronic effects based on a growth rate endpoint. The bioassay results are presented in Chapter 4 of the draft 2001 Cleanup Study Report, and the summary Table 4.8—Bioassay results and SMS Interpretations is attached.

Two of the stations tested that exceeded the SQS value of 47 mg/kg OC for bis (2-ethylhexyl) phthalate (DUD200, DUD201; 65- and 48 mg/kg OC, respectively) showed no toxicity in any of the three bioassay tests. Two other stations exceeded the CSL value

of 78 mg/kg OC (DUD202, DUD205; 110- and 84 mg/kg OC, respectively) and also showed no toxicity in any the three bioassay tests. The highest concentration at Station DUD202 was 1.4 times the CSL value, but showed no toxicity effects. Similar results were found in a sediment dilution study conducted on sediments from the Thea Foss Waterway in Commencement Bay, Washington. The highest concentration of bis (2-ethylhexyl) phthalate that showed no toxicity was 1.7 times the CSL value (45 percent Thea Foss sediment plus 55 percent dilution sediment). This data shows that the toxicity of phthalate is not as high as indicated by the SQS and CSL values.

8.3. Factors Supporting Remediation

Even though modeling results show phthalates will recontaminate the area near the Duwamish/Diagonal outfalls, there are factors that could justify proceeding with a sediment remediation action to remove PCBs. Some of these factors deal with the following issues: 1) the relative difficulty of achieving adequate phthalate source control to prevent recontamination, 2) the relative toxicity of the PCBs and phthalates to human health and biota, and 3) the relative size of potential phthalate recontamination compared to the total size of the PCB cleanup area.

Phthalates are a common chemical found in stormwater and CSO discharges. Although the concentrations are fairly low, the large stormwater volume of 1230 MGY results in substantial loading. It will not be possible to eliminate the phthalates in the short term, but it is possible to focus efforts on reducing sources where possible. Source control activities were discussed above that will focus on the Diagonal CSO/SD drainage basin in an effort to reduce the loading of phthalates.

The removal of PCB "hot spots" is a priority for regulatory agencies, the tribes, and project sponsors. The EBDRP panel has expressed a concern that PCBs pose a greater risk to human health and the environment than do phthalates. Because of this concern about PCBs it is considered important to move ahead with a sediment remediation action to remove PCBs even if there is a potential for part of the cleanup site to recontaminate with continuing phthalate discharges. The current sediment is contaminated with several highly toxic compounds. The remediation would replace this contamination with a clean site that has the potential to recontaminate over time with less toxic phthalates.

9. INPUT OF CHEMICALS FROM ADJACENT PROPERTY

The land on the inshore side of the Duwamish/Diagonal cleanup project is owned by the Port of Seattle and designated as terminals T106 and T108. In 1970, the Port made a major change in the east riverbank north (downstream) of the current Diagonal CSO/SD. A new river bank was established by installing a long rock bulkhead in the river and then back-filling the site to create about 900 linear feet of new river front property that is now T106. This construction activity is visible in the 1970 aerial photo C-2 in Appendix C of the draft 2001 Cleanup Study report. The property south the Diagonal CSO/SD outfall was the Diagonal Avenue South sewage treatment plant that closed in 1969 (also visible

on aerial photo C-2). After the treatment plant was removed, the property had two settling pond constructed on the north half to receive PCBs dredged from Slip 1 (visible on aerial photo C-3). In 1977, the Chiyoda Corporation moved the shoreline on part of the site about 100 feet inshore (visible on aerial photo C-4) and leveled the entire site. The LaFarge Corporation used the upstream half of the site for bulk dry cement receiving, storage, and trans-shipment during 1989 to 1998. The old LaFarge site is open for lease from the Port and the Port is using the rest of the property for container storage.

When the Port was contacted about obtaining property reports on T106 and T108, the Port informed us that they were assembling the same information to send to EPA as part of the Superfund potentially responsible party search and will be providing that data to EPA soon. Consequently, the following three categories may need to be updated when more details about T106 and T108 become available.

9.1 Surface Runoff

Aerial photos show that most of T106 and T108 are paved except near shore, which will prevent erosion by surface flow over contaminated soil. The quality of the material used to backfill the T106 property is not know at this time. At T108, there are several activities that resulted in contaminated sediment being deposited on site. One small storm drain on the south end of T106 once discharged to the small cove on the downstream side of the Diagonal CSO/SD. However, this pipe has been connected directly to the Diagonal CSO/SD pipe. Current activities that allow pollutants on the ground flow to the existing storm drains. At present, any of the runoff collected from these two properties are routed through the local drainage system to discharge at one of three locations: Nevada St. SD north of Area A, the Diagonal CSO/SD mid Area A, or the Diagonal Ave. S. SD south of Area B.

9.2 Ground Water

The Port collected ground water samples from the T108 property (old treatment plant) and should include this in the data they provide to EPA and Ecology. Groundwater samples were collected from 14 wells during October 1991 (dry season) and January 1992 (wet season). A discussion of this data was included in the draft 2001 Cleanup Study Report in section 3.2.7 and will be briefly discussed. Depth of ground water ranged from 2m to 4m, but discharge rates were not determined.

No PCBs were detected in 14 groundwater samples (detection limit 0.1 ug/l), but one duplicate sample had a value of 0.3 ug/l (Aroclor 1248). Because PCBs are not very mobile in groundwater and PCBs were generally undetected in groundwater samples, PCBs in groundwater are not expected to pose a risk to aquatic receptors in the waterway. Diesel fuel and gasoline were measured in nine of the 14 well at concentrations ranging from 30 to 490 ug/l. The PAH levels were compared to the Lowest Observed Effects Level of 300 ug/l, which resulted in the conclusion that it is unlikely that PAHs pose a risk to aquatic receptors in the waterway. The maximum concentrations of cadmium (38 ug/l), copper (200 ug/l), lead (260 ug/l), mercury (0.3 ug/l), nickel 380 ug/l) and zinc

(6,200ug/l) measured in groundwater samples exceeded ten times the marine chronic Water Quality Criteria and would need to be diluted 45-fold to meet the criteria. In the cleanup area, mercury is the only metal that exceed the sediment standard, and this tends to be in deeper water farther from the property or in one area inshore at T108 north of the Diagonal SCO/SD.

Ecology has pointed out that they consider the 1992 well sampling data from T-108 to be older then they prefer because the data is 10 years old. Ecology would prefer to see newer well data to verify that conditions still indicate there is no concern for ground water to be a potential recontamination source to the cleanup site. King County will investigate whether the Port of Seattle has collected newer well samples from T-108. If newer well sampling data is available then King County will insure Ecology and EPA get a copy as soon as possible. If only the 1992 well sampling data is available, then King County will work with Ecology, EPA and the Port of Seattle to obtain the data satisfactory to the regulatory agencies.

9.3. Bank Erosion

Down stream of the Diagonal CSO/SD the river bank is a large rock wall that extends about 900 feet down river. This rock wall was installed in the river and then filled behind to create the upland property. A small cove was created immediately downstream of the outfall and has some sediment, but this does not appear to be erosion from the nearby banks but possibly sediment from the outfall.

Upstream of the Diagonal CSO/SD most of the bank on the old treatment plant property has been stabilized with large rip rap. An area behind the pier has some exposed intertidal sediment. This sediment was sampled and chemical analysis results showed low chemical concentrations. The row of sediment samples collected closest to shore near the old treatment plant property showed low chemical concentrations. There is no indication of contaminated sediment located in the intertidal area, which could produce the kind of recontamination situation that was observed at the Norfolk sediment cleanup project. It also suggests that bank erosion along this stretch, if occurring, is not providing any significant source of contamination.

10. DREDGING ACTIVITIES AS PCB RECONTAMINATION SOURCE

The greatest threat of PCB recontamination in this section of the river is from potential dredging activities that disturb and mobilize contaminated sediments. To minimize the risk that the future Duwamish/Diagonal sediment remediation project could be recontaminated from nearby dredging activities, it is important to identify the location of sediment contamination and the potential dredging projects that could disturb these sediments

The PCBs present in sediments were introduced by historic sources and subsurface sediments typically have higher PCB values then surface Current discharge pipes are not

a concern for PCB recontamination, because the PCB levels are so low in the discharges. If PCB-contaminated sediments are disturbed, they could be mobilized and then redeposited on a nearby clean sediment remediation site. The degree of recontamination would vary depending on the amount of sediment that is redeposited on the remediation site and the PCB concentrations in the redeposited sediment. Any dredging activities that cannot be completed in one dredging season will cause additional sediment disturbance in a following year, thus increasing the time during which potential recontamination could occur. Coordination of dredging projects could reduce potential recontamination.

10.1. PCB Recontamination

A chemical hot spot containing high PCB values is located immediately upstream of the 4.8-acre cleanup area originally proposed for the Diagonal/Duwamish site. This hot spot was recognized as a potential source of PCB recontamination to the near-by sediment cleanup project. A complete description of the PCB recontamination modeling was included in Appendix P of the draft 2001 Cleanup Study Report and a short discussion was included in Chapter 7 of the report. Also, a two page summary of the modeling result was written and included in the new Expanded Area document that was prepared for the responsiveness summary.

The model predicted the highest rate of recontamination will occur if the upstream hot spot is dredged during some future cleanup action. Even without a cleanup project being conducted at the hot spot, it is predicted that propeller wash and river currents will resuspend some of the high PCB sediment, some of which will settle onto a near-by cleanup project. The Duwamish/Diagonal cleanup project has been expanded to include the upstream PCB hot spot. The expanded cleanup site eliminates both of these primary sources of potential recontamination and insures that the dredging at the hot spot will not recontaminate the cleanup in the future.

In 1984, the USACE conducted an emergency dredging action at the chemical hot spot location directly off the old treatment plant outfall to remove a shoal that had reduced the navigation channel depth down to -25 feet instead of the required -30 feet depth. The USACE removed one barge load of contaminated sediment to restore the channel depth. Detailed bathymetry from 1994 (Figure 2-4) shows "U" shaped contour lines located near the east channel line offshore from the old /Diagonal Ave. S. treatment plant outfall on surveys from 1992 and 1994 indicating that the USACE dredging extended slightly east of the east channel line. The source of this rapidly appearing shoal was not investigated at the time, but the volume of contaminated sediment is too large to be from an accidental barge dump. Close inspection of the detailed contour lines (Figure 2-4) shows that the 1977 dredging project created a small ridge of sediment on the upstream side of the old treatment plant outfall. If part of this narrow ridge of contaminated sediment was unstable and slid off into the channel in 1983, it could have produced the type of shoal that the USACE had to remove in 1984.

10.2. Future Maintenance Dredging Projects

The lower 9.6-km of the Duwamish River is maintained as a navigable waterway by the U.S. Army Corps of Engineers (USACE). In the Study Area the navigation channel is delineated by straight, parallel lines, generally aligned with the shore. The eastern side of the navigation channel is approximately 250 feet from the east bank of the River in the vicinity of the outfalls. The navigation channel is approximately 60 m (200 feet) wide and about 9 m (30 feet) deep (below MLLW; Weston 1993). According to USACE bathymetry, depths in the navigation channel range from 26 to 35 feet (all depths MLLW). Most of the channel was dredged prior to 1960, but a portion immediately upstream of the site was dredged in 1968 (Tetra Tech 1988).

The navigation channel is intended to be maintained at a depth of 30 feet. However, a 1997 USACE bottom survey showed that a shoal (about 50 feet wide and more than 1,200 feet long) has developed along the east side of the waterway across from Kellogg Island (see Figure 2-4). The northernmost portion of the shoal extends approximately to the Duwamish/Diagonal outfalls. Eventually, dredging of this area will be required to maintain the channel.

Cleanup Area B of the expanded Duwamish/Diagonal cleanup project extends into the navigation channel for 50 feet and will remove this shoal. The length of Cleanup Area B is about 500 feet so the project will remove 500 feet of the shoal, which is the entire down stream end of the shoal. The proposed remediation method for portions of the cleanup area located in the channel area or immediately adjacent to the channel is to over-dredge the area so that when the cap is installed, the top of the cap will be 2 feet below the navigation depth of minus 32 feet (MLLW). The contractor will dredge the area in the channel to a depth of minus 35 feet (MLLW) and then cap the area with a 3 foot thick layer of clean sand, which will result in the bottom elevation of minus 32 feet (MLLW). The 2 foot over-dredge will insure that any future maintenance dredging in the channel that is performed by the USACE will not affect the integrity of the containment cap nor expose contaminated sediments.

11. Slip #1 PCB SPILL AND CLEANUP ACTIONS

In 1974, a major PCB spill occurred at Slip # 1, which is located about 3,300 feet (1,000 meters) upstream of the Duwamish/Diagonal outfalls. About 255 gallons of near-pure PCB (Aroclor 1242) was spilled on September 13, 1974, when an electric transformer being loaded onto a barge was dropped and broken on the north pier of Slip 1. The majority of the PCBs were recovered during two separate dredging actions. In 1974, an initial clean-up was attempted using several hand dredges, which recovered approximately 80 gallons of PCB. Subsequent sampling determined that the remaining fluid had spread throughout the slip and into the river channel, requiring a second dredging. Prior to that second project, a “20-year flood” occurred during the winter of 1975/1976 and may have contributed to further spreading of contaminated sediments in the river channel.

In 1976, the U.S. Army Corps of Engineers (USACE) conducted a second dredging of PCBs at the northwest corner of Slip 1 using hydraulic dredging piping the slurry overland to settling ponds on the Chiyoda Corporation property (former Diagonal Avenue Sewage Treatment Plant property). Two lagoons were excavated along the northern edge of the property in the former sewage treatment plant sludge bed areas for treatment of about 10 million gallons of PCB-contaminated sediment. Most of the contaminated PCB sediment was deposited in the first receiving lagoon located closest to the river. The second lagoon received the overflow water from the first lagoon. Water pumped from the disposal lagoons was filtered through a sand, and charcoal filter to remove suspended particles and PCBs prior to discharge to the Duwamish Waterway.

A report prepared by the USACE in 1978 estimated that the dredging removed another 170 gallons of the 255-gallon spill of Aroclor 1242 resulting in a total recovery of about 98 percent. Post-spill sediment concentrations of Aroclor 1242 ranged from 0.06 to 2400 ppm in the vicinity of the spill. The highest concentrations were at the immediate location of the spill. Post-dredge (5/4/76) sediment concentrations ranged from 0.03 to 140 ppm Aroclor 1242, with the highest concentration at the remediated spill site. PCB concentrations were also monitored during the cleanup operation and mean concentrations were within the normal observed ranges. The report concluded that based on these monitoring results, the spill did not contribute a significant PCB loading to the Duwamish River. However, sediment samples taken by EPA in 1998 showed measurable levels of PCBs remain in the sediment in the dredged channel both upstream and down stream of Slip 1 (Weston 1999). The sediments that were dredged in 1974 and 1976 contained other PCB Aroclors in addition to Aroclor 1242, which brings up the possibility that both these dredging projects to remove the Aroclor 1242 could have spread sediments with other Aroclors into the navigation channel.

12. INSTITUTIONAL CONTROLS NEEDED TO PROTECT CAP

Institutional controls are restrictions that are applied to the property to limit the type of activity that can be conducted on the property. Specific institutional controls will needed to be established to protect the integrity of the Duwamish/Diagonal sediment cap and will serve as a restrictive covenant for the property. The Port of Seattle owns and manages the river bottom where the cleanup project will be conducted. Consequently, the Port of Seattle will be the authority that must agree to institutional controls and also enforce the institutional controls.

Institutional controls are established to prevent various activities that could cause damage to the cap, which could then result in the release of the underlying contaminated sediment. Examples of activities that could cause damage to the cap are dredging, anchoring, installing pilings and other construction activities. Some activities may be prohibited completely, and other activities may be allowed with proper precautions and restrictions. For example, anchoring of large vessels with large anchors would be prohibited to prevent large anchors from digging holes in the cap. However, use of small anchors for Tribal fishing nets would be allowed. The instillation of permanent anchor

points is one method that has been used to minimize the impact of anchoring on reefs. Any proposals for major activities like piling installation, in-water construction, and dredging would be evaluated with the understanding that the sediment cap must not be compromised.

When a capping remedy is used for a Superfund sediment cleanup project, EPA requires the landowner to sign a legal agreement with EPA. The agreement provides legal assurance from the landowner that the cap would not be disturbed, or if future development plans did call for disturbance of the cleanup area, the landowner would coordinate with EPA to ensure that the contaminated materials would be addressed in a protective manner. This agreement generally takes the form of a Consent Decree with EPA.

The Duwamish/Diagonal cleanup project is not a Superfund project, but is proceeding under the SMS process with Ecology as the lead agency. Consequently, during the Port approval process, King County will request that the Port provide written agreement to EPA and Ecology that the Port will adhere to all institutional controls established for the Duwamish/Diagonal site. King County will request that the Port execute a restrictive covenant that is enforceable by both EPA and Ecology.

13. MONITORING OF CAPPING PROJECT

Appendix Q of the draft 2001 Cleanup Study Report contains a preliminary draft of a Construction and Post-Construction Monitoring Plan for cleanup Area A. This draft monitoring plan extends over a period of 10 years and will be expanded to included cleanup Area B. It is envisioned that the monitoring plan will be updated and revised following final design and permitting. The hydraulic permit issued by the Washington State Department of Fish and Wildlife typically requires a formal monitoring plan to approve sediment cleanup projects (required for 1999 EBDRP Norfolk CSO/SD cleanup project).

Environmental monitoring for the Duwamish/Diagonal cleanup project involves both short-term and long-term activities. Various short-term monitoring activities are needed to facilitate dredging activities and the placement of capping material according to plan specifications. There are two long-term monitoring activities, which focus on documenting stability of the sediment cap and also determining the amount of chemical recontamination that occurs on the surface of the cap. The strategy for long-term monitoring is to conduct sampling more frequently during the early years after capping and then to reduce the frequency of sampling over time. The long-term activities are patterned after the 10 year monitoring plan being carried out at another EBDRP sediment capping project called the Pier 53-55 capping project, which was constructed in Elliott Bay during 1992.

There are seven main objectives associated with the monitoring plan and these objectives apply to both cleanup Areas A and B. Each objective is listed below along with a

summary of the main activities included in the monitoring program to achieve these objectives (see Appendix Q for additional information). The first four objectives pertain to short-term monitoring activities, while the last 3 objectives pertain to long-term monitoring.

13.1. Short-Term Construction Monitoring

Monitoring Objective # 1 is to ensure that water quality guidelines are met during dredging, and transport of contaminated sediment from the dredging barge to the rail/truck loading area. Most of the chemical pollutants in the sediments to be dredged stay attached to the sediment particles and do not become soluble in river water. Prior to field dredging operation, the existing chemistry data from the site assessment at Duwamish/Diagonal will be used to calculate a TCLP (Toxic Characteristic Leaching Procedure) prescreening to see if chemical levels in sediments are predicted to be a potential problem for leaching. If chemicals exceed the TCLP prescreening, then additional sediment sampling will be performed during the design phase to directly measure the potential for contaminants to leach from the sediment during dewatering on the barge and whether this would pose any adverse impact to the receiving waters.

Turbidity is another water quality parameter that has established standards, but this parameter is not always measured. Turbidity monitoring of the water column is not currently proposed during dredging operations, but could be included if required by permitting agencies. There are three main reasons for not recommending turbidity monitoring: 1) Dredging will occur during the winter flood season when there is typically high river flow and high turbidity; 2) The winter dredging window has been established for regulatory purposes because during this time of year there is minimal use of the river by important salmonid species; 3) Dredging at the Duwamish/Diagonal site represents a relatively small volume of material compared to maintenance dredging projects. As in past sediment cleanup projects, the contractor will be required to conduct the dredging operations at the Duwamish/Diagonal site with care to minimize the amount of turbidity produced. If water column sampling were required during dredging operations, King County Environmental Laboratory (KCEL) staff would collect the turbidity data using PSEP recommended guidelines (PSEP 1996).

Monitoring Objective # 2 is to insure that the dredging and capping constructions are performed according to plan specification. The dredging depths and capping elevations will be monitored to document that the construction of the cap adheres to the specifications in the dredge and cap plan. Accurate measurements of the dredging depths and capping depths are required because the payment schedule for the construction contractor is based on the calculated volume of material dredged and the calculated volume of capping material placed on the site. Detailed bottom depth surveys will be conducted prior to dredging, after dredging is completed, and after the capping material has been placed. If surveys detect deviations from either the dredging or capping plan, the contractor will be required to make corrections, which will be verified by conducting additional bottom depth surveys.

Monitoring Objective # 3 is to verify that the dredged material is below the PCB dangerous waste level (50 ppm) and will be acceptable for landfill disposal. For those areas of the cleanup Area A and B that are anticipated to contain the highest PCB values, a few composite samples of the dredged material will be collected from the haul barge and analyzed over night to determine the PCB concentration. Previous sampling at the Duwamish/Diagonal site has shown that in cleanup Area A all samples were well below the PCB dangerous waste value of 50 ppm, which means that all dredged sediment is anticipated to be acceptable for disposal at an approved landfill. In cleanup Area B one of the 3 surface samples from the hot spot had a value of 85 ppm (station DUD 027), which is over the dangerous waste value of 50 ppm. A core sample collected from this same station contained a value of 9 ppm in the 0-3 foot section with the highest value of 23 ppm in the 3-6 foot section. This data showed that even though the surface grab exceeded the dangerous waste value of 50 ppm, the core samples were substantially below the standard. The composite sample will be collected from the barge of dredged sediment and analyzed over night. If the composite sample of dredged sediment shows PCBs at a value of 45 ppm or greater, then the disposal contractor will be notified and the associated batch of dredge material will be directed to a landfill approved to take hazardous waste.

Monitoring Objective # 4 is to make sure that the capping backfill material is clean prior to placement. The chemical quality of the capping backfill material will be determined base on collecting and analyzing one composite sample of the capping backfill material prior to placement of the capping material. If this capping material is obtained from maintenance dredging at the head of navigation channel in the Duwamish River, the sediment chemistry quality data routinely produced by the U.S. Army Corps of Engineers for open water disposal will be compared to the SMS as a preliminary screening. Confirmatory testing of maintenance dredge material will be performed on the first load of dredge material while it is on the barge. Staff from King County environmental laboratory will collect and analyze the composite sample to represent sediment quality of the entire barge load. If capping material is purchased from a supplier, one composite sample will be collected and analyzed prior to acceptance and placement of the material.

13.2. Long-Term Monitoring

Monitoring Objective #5 is to document cap stability for isolating contaminants over time. Checking for sediment erosion using one of two methods will monitor stability of the cap material. The preferred method for measuring erosion is to use a grid of fixed measuring stakes that extent through the cap and also extend above the cap to allow measurement. However, concern has been raised that the fixed stakes would become an obstruction for Tribal gill net fishing activities conducted in this area of the river. Efforts will be made to design a flexible stake (similar to a bicycle flagpole) that would not snag gill nets and would be approved by the tribe. A grid of 13 stakes was proposed for Area A, but a grid pattern has not yet been proposed for Area B.

The alternate approach that could be used to measure cap erosion is to conduct detailed bottom depth surveys each monitoring year similar to the detailed bottom survey that was

conducted at the end of cap construction to verify the cap surface elevations. Survey data from each year would be used as input to a computer program designed to calculate the bottom elevations of the cap surface. If bottom depth increased then erosion would be indicated and would be evaluated by taking sediment cores. If cores confirmed erosion, then meetings would be held with regulatory agencies to determine the cause and required solution.

Monitoring Objective # 6 is to document future recontamination of the cleanup Area A from continuing point source discharges from the Diagonal CSO/SD outfall (primarily the 1,230 MGY of separated storm water). Accumulation of surface sediment contamination on the Duwamish/Diagonal sediment cap will be evaluated by collecting and analyzing grab samples from five stations. These stations are in a "V" pattern with the point towards the outfall.

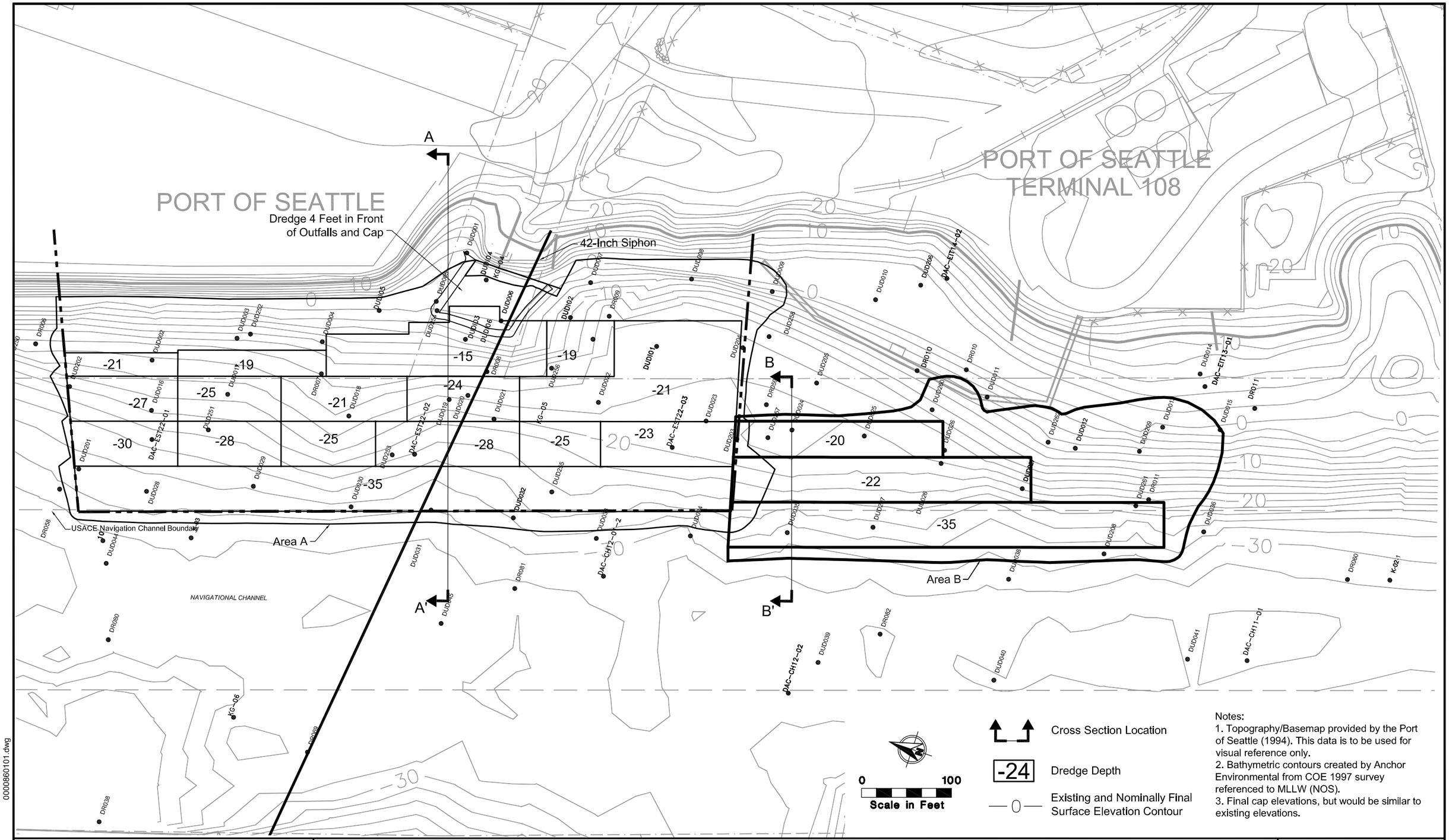
Monitoring Objective # 7 is to document whether PCB contamination located on adjacent property migrates onto the cap. Now that the cleanup project has been expanded to remove the PCB hot spot there should be minimal PCB recontamination from surrounding areas. Two or three surface grab stations would be placed on cleanup Area B to document any potential PCB recontamination to the cleanup area.

Staff from King County environmental laboratory will collect all surface samples using a small vessel outfitted with a crane and Van Veen grab sampler. All samples will be collected, handled, and processed in accordance with previous Duwamish/Diagonal Sampling and Analysis Plans/Addenda (EBDRP 1994, 1995). At each station a minimum of three grab samples will be composited and homogenized for laboratory analysis. A stainless steel spoon will be used to collect the top 10 centimeters of sediment from three replicate grab samples per station. Each 0-10 cm composite sample will be analyzed for SMS chemicals and associated parameters such as total organic carbon, total solids, and particle size distribution.

The cap will be sampled within 3 months after cap placement to document baseline surface sediment conditions. Surface sediment stations will be sampled each year for the first 5 years following cap placement. However, the frequency of sampling events to be carried out during the second 5 years of the 10-year monitoring will be determined based on the rate of recontamination during the first 5 years. If recontamination appears to be stabilized, then sampling may be reduced to alternating years or longer between sampling events. A project monitoring review meeting will be held after 5 years to decide future monitoring frequency. Chemistry data for each station will be reported in dry weight values to show trends in chemical levels each year and will also be normalized to organic carbon where appropriate for comparison to SMS criteria values.

Modifications may be required to the monitoring plan before it is finalized. During the permitting process and public review for the project, regulatory agencies or affected parties may request additional monitoring. Even after the annual monitoring program is underway, revisions may be needed to the monitoring plan to respond to the results obtained. For example, if chemical levels in surface sediments eventually reach the CSL

value for phthalates, then the monitoring program will be expanded to include bioassay testing methods outlined in the sediment management standards, which will show whether biological toxicity occurs at the numeric CSL value.



EcoChem Team

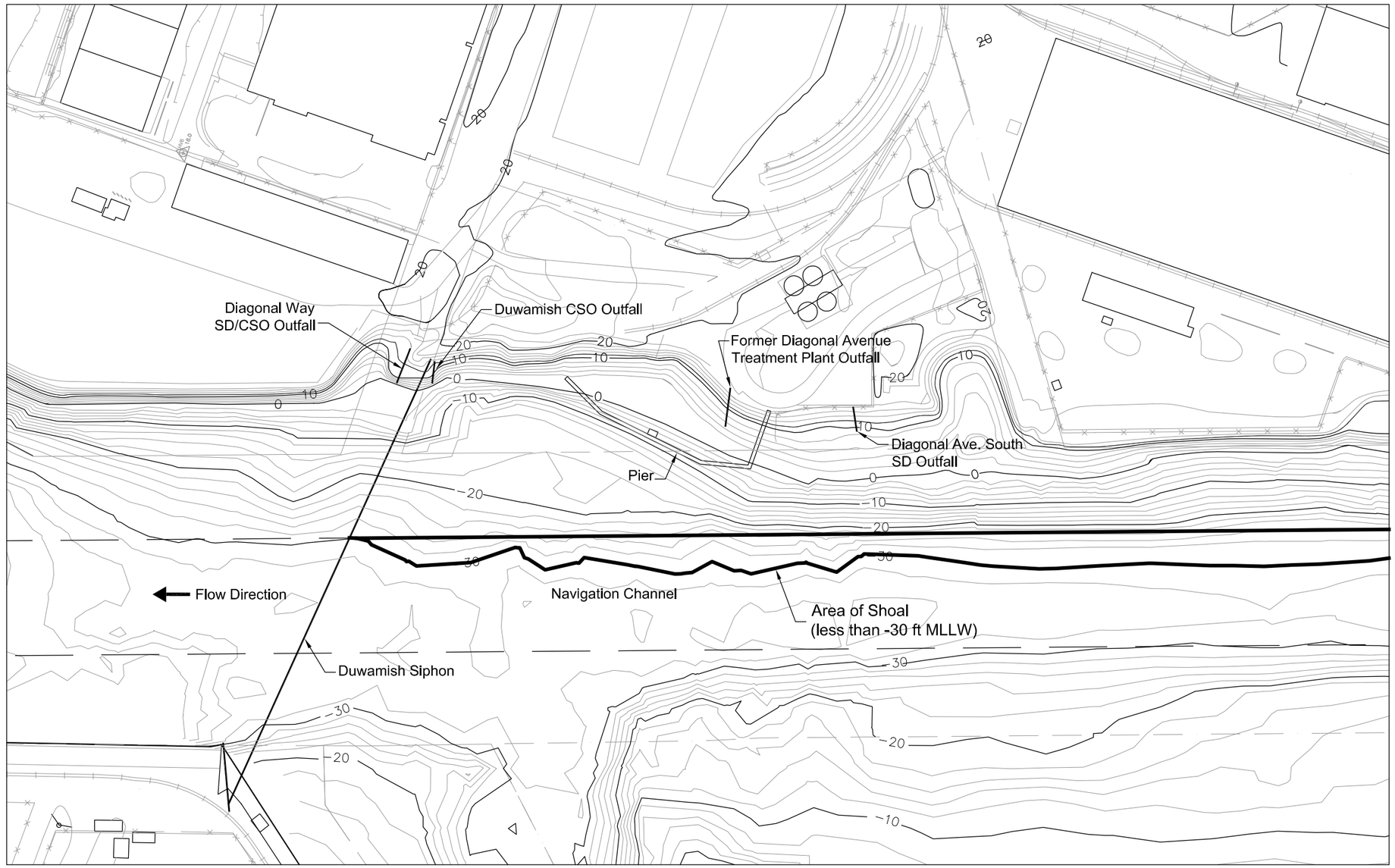
Duwamish/Diagonal Sediment Remediation Project

Alternative 3: No Change in Existing Elevations, Dredge Layout (Plan View; including Area B Removal)

Figure EX-1

0000860101.dwg

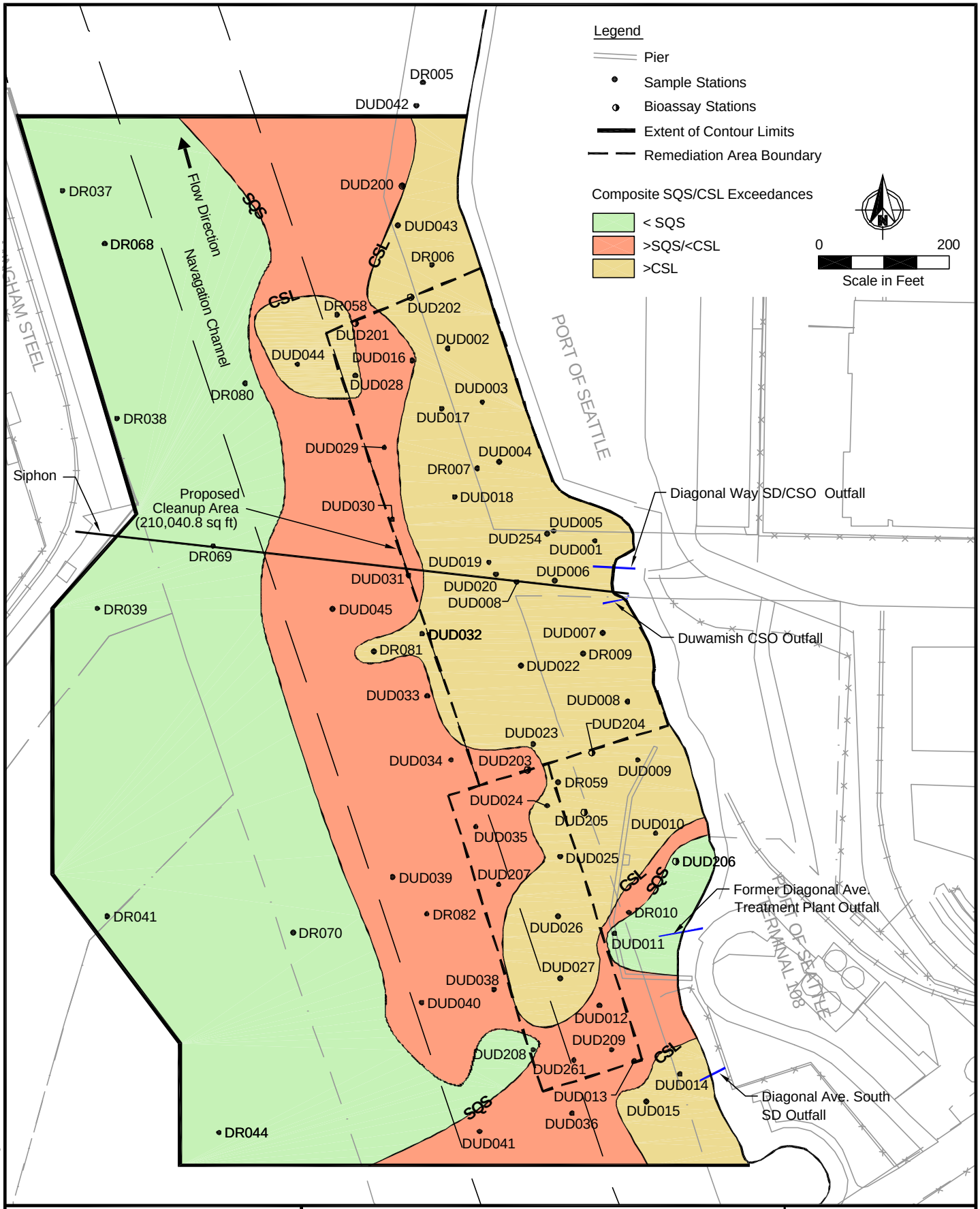
4/4/02



Notes:
1. Topography/Basemap provided by the Port of Seattle (1994). This data is to be used for visual reference only.
2. Bathymetric contours created by Anchor Environmental from USACE 1997 survey referenced to MLLW (NOS).

EcoChem Team	Duwamish/Diagonal Sediment Remediation Project	Figure 2-4
	Shoreline Features and Bathymetry	

00-086-01
DWD018-01.dwg
12/20/01



EcoChem Team

Duwamish/Diagonal Sediment Remediation Project

Composite SQS/CSL Exceedance Areas

Figure 5-9

5/9/02 DWD-000086601-19.dwg cvd

Memo

To: Pat Romberg

From: Zhong Ji

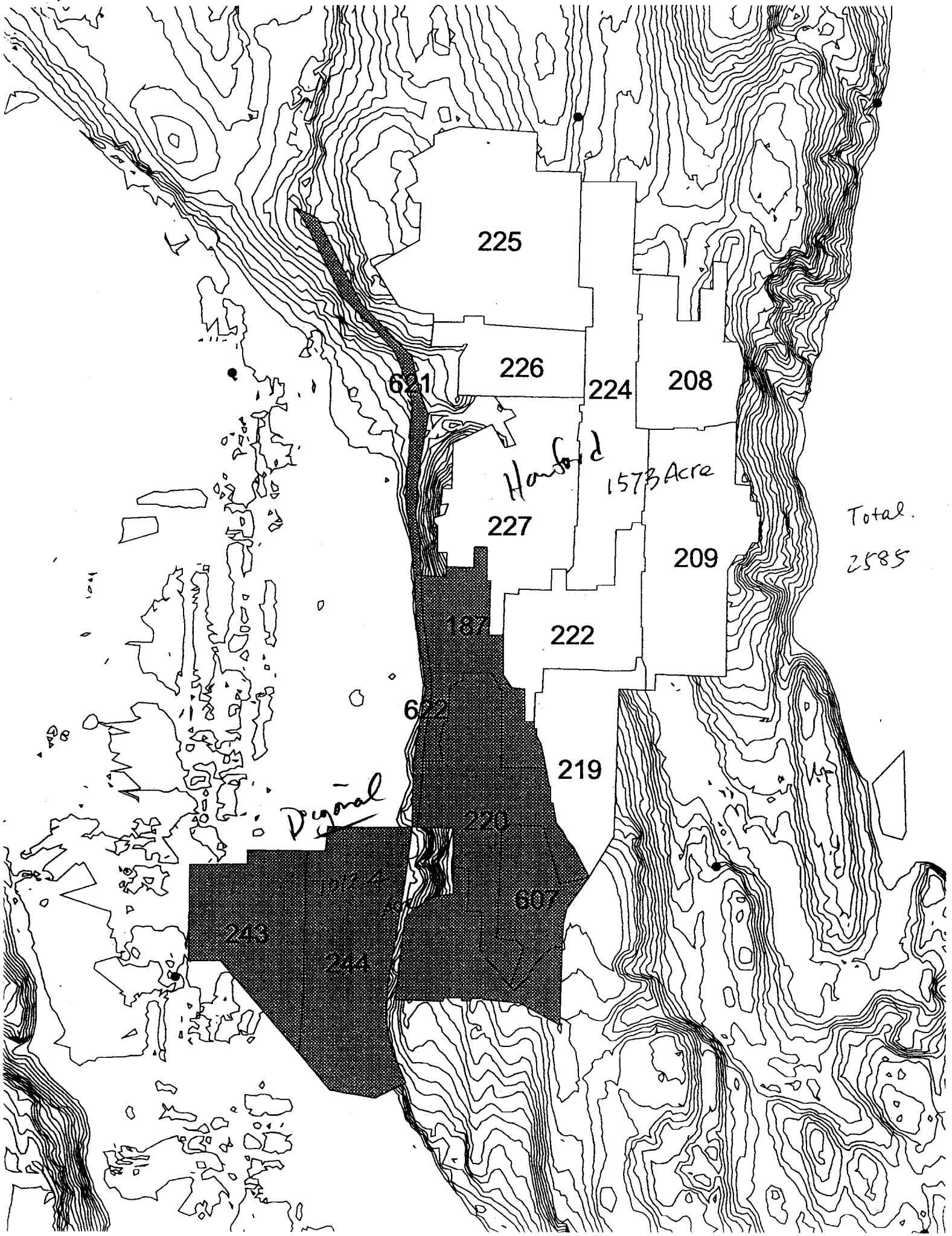
CC: Bob Swarner

Date: 10/01/97

Re: Stormwater Discharge From Duwamish Diagonal Storm Drain

The attached map shows the catchment basins for both Hanford and Diagonal Avenue Storm drains. The stormwater from the yellow colored basins is through Hanford tunnel. The total basin area for the yellow colored area is 1573 acres. The green area is the natural drainage basin to the Diagonal Avenue storm drain. The total area for the green colored basins is 1012 acres.

The annual stormwater volume from Hanford and Diagonal Avenue drainage areas is 1230 million gallons based on the 1978 to 1986, 1994 to 1996 water-year runoff model simulation.


225
226
621
224
208
Hanford
1573 Acre
227
209
Total.
2585
187
222
622
219
Dygnal
220
607
243
244

Quality Assurance Reviews

Quality Assurance Review for Duwamish Estuary Water Quality Assessment Sediment Project Weeks One Through Six (Report), May 29, 1997

Quality Assurance Review for Duwamish Estuary Water Quality Assessment Sediment Project Weeks Seven Through Seventeen (Report), July 31, 1997

Quality Assurance Review for Duwamish/Estuary Benthic Invertebrate Study Sediment Chemistry (Report), December 23, 1997

Quality Assurance Review for Duwamish/Estuary Benthic Invertebrate Study Sediment Chemistry - Archived Samples (Report), . . . to be completed

Tissue Data

Data Reports

8000CB.XLS Crab Tissue Chemistry Data

8001CB.XLS Invertebrate Tissue Chemistry Data

8002CB.XLS Large Fish Tissue Chemistry Data

8003CB.XLS Small Fish Tissue Chemistry Data

8004CB.XLS Squid Tissue Chemistry Data

8005CB.XLS Miscellaneous (Crab, Mussels, Prawns) Tissue Chemistry Data

8006CB.XLS Transplanted Mussel Study (Phase I) Chemistry Data

8007CB.XLS Transplanted Mussel Study (Phase II) Chemistry Data

Quality Assurance Reviews

Quality Assurance Review for Duwamish Estuary/Elliott Bay Crab Tissue Study (Report), October 22, 1997

Quality Assurance Review for Duwamish Estuary/Elliott Bay Invertebrate Tissue Study (Report), October 20, 1997

Quality Assurance Review for Duwamish Estuary/Elliott Bay Large Fish Tissue Study (Report), October 18, 1997

Quality Assurance Review for Duwamish Estuary/Elliott Bay Small Fish Tissue Study (Report), October 17, 1997

Quality Assurance Review for Duwamish Estuary/Elliott Bay Squid Tissue Study (Report), February 5, 1998

8061CB.XLS Receiving Water Analytical Data - Week Twenty Four (05/20/97)

8062CB.XLS Receiving Water Analytical Data --Week Twenty Five (05/28/97)

8063CB.XLS Receiving Water Analytical Data - Storm Event of 05/31/97 - Day One (06/01/97) - Week Twenty Six

8064CB.XLS Receiving Water Analytical Data - Storm Event of 05/31/97 - Day Two (06/02/97) - Week Twenty Six

8065CB.XLS Receiving Water Analytical Data - Storm Event of 05/31/97 - Day Three (06/03/97) - Week Twenty Six

Quality Assurance Reviews

Final Data Package for Semipermeable Membrane Device Analytical Data (Technical Memorandum), July 28, 1997 (this package includes the quality assurance review and the analytical data report)

Quality Assurance Review of Conventional Analytical Data for Water Samples (Technical Memorandum), June 27, 1997

Quality Assurance Review of Low Level Mercury Data for Water Samples (Technical Memorandum), July 28, 1997 (this review includes the analytical data report)

Quality Assurance Review of Metals Analytical Data for Water Samples - First Thirteen Weeks (Technical Memorandum), August 29, 1997

Quality Assurance Review of Metals Analytical Data for Water Samples - Second Thirteen Weeks (Technical Memorandum), November 7, 1997

Quality Assurance Review of Organic Analytical Data for Water Samples (Technical Memorandum), June 18, 1997

Sediment Data

Data Reports

8008CB.XLS Brandon Street CSO Sediment Chemistry Data

8009CB.XLS Eighth Avenue CSO Sediment Chemistry Data

8010CB.XLS Hamm Creek Delta Sediment Chemistry

8011CB.XLS Kellogg Island Sediment Chemistry Data

8012CB.XLS South Park (16th Avenue South Bridge) Sediment Chemistry Data

8013CB.XLS Benthic Invertebrate Study Sediment Chemistry Data (Duwamish/Diagonal CSO and Kellogg Island)

8038CB.XLS Receiving Water Analytical Data - Storm Event of 12/04/96 - Day One (12/05/96) - Week Six

8039CB.XLS Receiving Water Analytical Data - Storm Event of 12/04/96 - Day Two (12/06/96) - Week Six

8040CB.XLS Receiving Water Analytical Data - Storm Event of 12/04/96 - Day Three (12/07/96) - Week Six

8041CB.XLS Receiving Water Analytical Data - Week Seven (12/11/96)

8042CB.XLS Receiving Water Analytical Data - Week Eight (12/18/96)

8043CB.XLS Receiving Water Analytical Data - Week Nine (01/29/97)

8044CB.XLS Receiving Water Analytical Data - Week Ten (02/05/97)

8045CB.XLS Receiving Water Analytical Data - Week Eleven (02/19/97)

8046CB.XLS Receiving Water Analytical Data - Week Twelve (02/26/97)

8047CB.XLS Receiving Water Analytical Data - Week Thirteen (03/05/97)

8048CB.XLS Receiving Water Analytical Data - Week Fourteen (03/12/97)

8049CB.XLS Receiving Water Analytical Data - Storm Event of 03/15/97 - Day One (03/16/97) - Week Fifteen

8050CB.XLS Receiving Water Analytical Data - Storm Event of 03/15/97 - Day Two (03/17/97) - Week Fifteen

8051CB.XLS Receiving Water Analytical Data - Storm Event of 03/15/97 - Day Three (03/18/97) - Week Fifteen

8052CB.XLS Receiving Water Analytical Data - Week Sixteen (03/26/97)

8053CB.XLS Receiving Water Analytical Data - Week Seventeen (04/02/97)

8054CB.XLS Receiving Water Analytical Data - Week Eighteen (04/09/97)

8055CB.XLS Receiving Water Analytical Data - Week Nineteen (04/15/97)

8056CB.XLS Receiving Water Analytical Data - Storm Event of 04/19/97 - Day Two (04/21/97) - Week Twenty

8057CB.XLS Receiving Water Analytical Data - Storm Event of 04/19/97 - Day Three (04/22/97) - Week Twenty

8058CB.XLS Receiving Water Analytical Data - Week Twenty One (04/30/97)

8059CB.XLS Receiving Water Analytical Data - Week Twenty Two (05/07/97)

8060CB.XLS Receiving Water Analytical Data - Week Twenty Three (05/15/97)

8024CB.XLS CSO Discharge Event of 12/04/96 (Brandon Street, Chelan Avenue, Connecticut Street, Hanford Street, and King Street CSOs)

8025CB.XLS CSO Discharge Event of 01/27/97 (Brandon Street, Hanford Street, and King Street CSOs)

8026CB.XLS CSO Discharge Event of 01/30/97 (Brandon Street, Hanford Street, and King Street CSOs)

8027CB.XLS CSO Discharge Event of 03/01/97 (Brandon Street, Hanford Street, and King Street CSOs)

8028CB.XLS CSO Discharge Event of 03/06/97 (Hanford Street and King Street CSOs)

8029CB.XLS CSO Discharge Event of 03/15/97 (Brandon Street, Chelan Avenue, Hanford Street, and King Street CSOs)

8030CB.XLS CSO Discharge Event of 04/19/97 (Brandon Street, Chelan Avenue, Connecticut Street, Hanford Street, and King Street CSOs)

8031CB.XLS CSO Discharge Event of 04/26/97 (Brandon Street CSO)

8032CB.XLS CSO Discharge Event of 05/31/97 (Brandon Street, Chelan Avenue, Connecticut Street, Hanford Street, and King Street CSOs)

Quality Assurance Reviews

Quality Assurance Review of Conventional Analytical Data for Water Samples (Technical Memorandum), June 27, 1997

Quality Assurance Review of Metals Data for CSO Storm Water Samples (Technical Memorandum), August 26, 1997

Quality Assurance Review of Organic Analytical Data for Water Samples (Technical Memorandum), June 18, 1997

Receiving Water Data

Data Reports

8033CB.XLS Receiving Water Analytical Data - Week One (10/30/96)

8034CB.XLS Receiving Water Analytical Data - Week Two (11/06/96)

8035CB.XLS Receiving Water Analytical Data - Week Three (11/13/96)

8036CB.XLS Receiving Water Analytical Data - Week Four (11/20/96)

8037CB.XLS Receiving Water Analytical Data - Week Five (11/25/96)

BIBLIOGRAPHY OF DATA REPORTS AND QUALITY ASSURANCE REVIEWS

The following data reports and supporting quality assurance (QA) reviews are available upon request. Data reports are available as Microsoft® Excel 5.0 spreadsheets, either electronically or in hard copy. QA reviews are available as reports or technical memoranda in hard copy only either comb-bound or loose. It is recommended that, when requesting a data report, the associated QA review also be requested. This will allow the user to evaluate the data in the context of its overall quality. To receive copies of any of the following documents, please contact:

Scott Mickelson
King County Environmental Laboratory
322 West Ewing Street
Seattle, Washington 98119-1507
(206) 684-2377 (phone)
(206) 684-2395 (fax)
scott.mickelson@metrokc.gov (e-mail)

Combined Sewer Overflow (CSO) Effluent Data

Data Reports

8014CB.XLS CSO Discharge Event of 03/29/96 to 04/01/96 (Brandon Street, Hanford Street, and Connecticut Street CSOs)

8015CB.XLS CSO Discharge Event of 04/15/96 to 04/16/96 (Brandon Street and Hanford Street CSOs)

8016CB.XLS CSO Discharge Event of 04/22/96 to 04/23/96 (Brandon Street, Chelan Avenue, Connecticut Street, Hanford Street, and King Street CSOs)

8017CB.XLS CSO Discharge Event of 05/22/96 (Brandon Street, Connecticut Street, and Hanford Street CSOs)

8018CB.XLS CSO Discharge Event of 08/02/97 (Brandon Street CSO)

8019CB.XLS CSO Discharge Event of 10/13/96 (Brandon Street CSO)

8020CB.XLS CSO Discharge Event of 10/17/96 (Connecticut Street, Hanford Street, and King Street CSOs)

8021CB.XLS CSO Discharge Event of 10/21/96 (Chelan Avenue and Hanford Street CSOs)

8022CB.XLS CSO Discharge Event of 10/28/96 (Hanford Street CSO)

8023CB.XLS CSO Discharge Event of 11/12/96 (Brandon Street CSO)

APPENDIX L

BIBLIOGRAPHY OF DATA REPORTS AND QUALITY ASSURANCE REVIEWS

King County Combined Sewer Overflow Water Quality Assessment for the Duwamish River and Elliott Bay

Appendices

Prepared by the

Duwamish River and Elliott Bay
Water Quality Assessment Team

Draft July 21, 1998

2002 PIPE SEDIMENT

Table C-3. Sediment Sample Semivolatile Organic Compound and Polychlorinated Biphenyls Analytical Results (Page 2 of 3)
Diagonal Storm Drain Cleaning Preparation
Seattle Public Utilities
January/February 2002

Compound	Marine Sediment Quality Standard	Units	Sample Designation: DS-T2-SS			DS-T2b-SS			DS-T3a-DS1b-SS			DS-T6b-SS			DS-T8b-SS		
			Result (ug/kg)	Q	Result (mg/kg OC)	Result (ug/kg)	Q	Result (mg/kg OC)	Result (ug/kg)	Q	Result (mg/kg OC)	Result (ug/kg)	Q	Result (mg/kg OC)	Result (ug/kg)	Q	Result (mg/kg OC)
LPAH	370	mg/kg OC	**54**		**10**	**470**		**18**	**910**		**12**	**790**		**14**	**490**		**25**
Naphthalene	99	mg/kg OC	20	U	4	110	U	4	290	U	4	230	U	4	98	U	5
Acenaphthylene	66	mg/kg OC	20	U	4	110	U	4	290	U	4	230	U	4	98	U	5
Acenaphthene	16	mg/kg OC	20	U	4	110	U	4	290	U	4	230	U	4	98	U	5
Fluorene	23	mg/kg OC	20	U	4	110	U	4	290	U	4	230	U	4	98	U	5
Phenanthrene	100	mg/kg OC	**54**		**10**	**470**		**18**	**910**		**12**	**790**		**14**	**490**		**25**
Anthracene	220	mg/kg OC	20	U	4	110	U	4	290	U	4	230	U	4	98	U	5
2-Methylnaphthalene	38	mg/kg OC	20	U	4	110	U	4	290	U	4	230	U	4	98	U	5
HPAH	960	mg/kg OC	**408**		**76**	**4810**		**182**	**7530**		**103**	**5870**		**103**	**4840**		**244**
Fluoranthene	160	mg/kg OC	**74**		**14**	**1300**		**49**	**1400**		**19**	**1600**		**28**	**1200**		**61**
Pyrene	1000	mg/kg OC	**71**		**13**	**810**		**31**	**1400**		**19**	**980**		**17**	**680**		**34**
Benzo(a)anthracene	110	mg/kg OC	**31**		**6**	**300**		**11**	**530**	M	**7**	**490**		**9**	**400**		**20**
Chrysene	110	mg/kg OC	**54**		**10**	**590**		**22**	**880**		**12**	**810**		**14**	**590**		**30**
Benzo(b)fluoranthene	230	mg/kg OC	**41**		**8**	**630**	M	**24**	**1000**		**14**	**780**	M	**14**	**570**	M	**29**
Benzo(k)fluoranthene	230	mg/kg OC	**56**		**10**	**410**		**16**	**840**		**11**	**660**	M	**12**	**630**		**32**
Benzo(a)pyrene	99	mg/kg OC	**37**		**7**	**410**		**16**	**670**		**9**	**550**		**10**	**470**		**24**
Indeno(1,2,3,c-d)pyrene	34	mg/kg OC	**23**		**4**	**170**		**6**	**370**		**5**	230	U	4	**150**		**8**
Dibenzo(a,h)anthracene	12	mg/kg OC	20	U	4	110	U	4	290	U	4	230	U	4	98	U	5
Benzo(g,h,i)perylene	31	mg/kg OC	**21**		**4**	**190**	M	7	**440**		**6**	230	U	4	**150**	M	**8**
Total Benzofluoranthenes	230	mg/kg OC	**97**		**18**	**1040**		**39**	**1840**		**25**	**1440**		**25**	**1200**		**61**
1,2-Dichlorobenzene	2.3	mg/kg OC	20	U	3.7	110	U	4.2	290	U	4.0	230	U	4.0	98	U	4.9
1,4-Dichlorobenzene	3.1	mg/kg OC	20	U	3.7	110	U	4.2	290	U	4.0	230	U	4.0	98	U	4.9
1,2,4-Trichlorobenzene	0.81	mg/kg OC	20	U	3.7	110	U	4.17	290	U	4.0	230	U	4.0	98	U	4.9
Hexachlorobenzene	0.38	mg/kg OC	20	U	3.7	110	U	4.17	290	U	4.0	230	U	4.0	98	U	4.9
Dimethyl Phthalate	53	mg/kg OC	**140**		**26**	110	U	4	290	U	4	230	U	4	98	U	5
Diethyl Phthalate	61	mg/kg OC	20	U	4	110	U	4	290	U	4	230	U	4	98	U	5
Di-n-butyl Phthalate	220	mg/kg OC	20	U	4	110	U	4	290	U	4	230	U	4	98	U	5
Butyl Benzyl Phthalate	4.9	mg/kg OC	**23**		**4.3**	110	U	4.2	**600**	M	**8.2**	**900**	M	**15.8**	**100**		**5.1**
Bis(2-ethylhexyl)phthalate	47	mg/kg OC	**230**		**43**	**3800**		**144**	**8900**		**121**	**5300**		**93%**	**5500**		**278**
Di-n-octyl Phthalate	58	mg/kg OC	20	U	4	**230**		**9**	**690**		**9**	**780**		**14**	**700**		**35**
Dibenzofuran	15	mg/kg OC	20	U	4	110	U	4	290	U	4	230	U	4	98	U	5
Hexachlorobutadiene	3.9	mg/kg OC	39	U	7.3	230	U	8.7	290	U	4.0	470	U	8.2	200	U	10.1
N-nitrosodiphenylamine	11	mg/kg OC	20	U	4	110	U	4	290	U	4	230	U	4	98	U	5
Aroclor 1016	12	mg/kg OC	60	U	11	79	U	3	120	U	2	72	U	1	67	U	3
Aroclor 1221	12	mg/kg OC	60	U	11	79	U	3	120	U	2	72	U	1	67	U	3
Aroclor 1232	12	mg/kg OC	60	U	11	79	U	3	120	U	2	72	U	1	67	U	3
Aroclor 1242	12	mg/kg OC	60	U	11	79	U	3	120	U	2	72	U	1	67	U	3
Aroclor 1248	12	mg/kg OC	60	U	11	79	U	3	120	U	2	**370**		**6.5**	67	U	3
Aroclor 1254	12	mg/kg OC	60	U	11	**620**		**23.5**	**220**		**3.0**	72	U	1	67	U	3
Aroclor 1260	12	mg/kg OC	60	U	11	**320**		**12.1**	**160**		**2.2**	**110**		**1.9**	67	U	3
Total PCBs	12	mg/kg OC	60	U	11	**940**		**35.6**	**380**		**5.2**	**480**		**8.4**	67	U	3
Phenol	420	ug/kg	39	U	---	230	U	---	570	U	---	470	U	---	200	U	---
2-Methylphenol	63	ug/kg	20	U	---	230	U	---	290	U	---	230	U	---	98	U	---
4-Methylphenol	670	ug/kg	20	U	---	230	U	---	290	U	---	230	U	---	98	U	---
2,4-Dimethylphenol	29	ug/kg	59	U	---	340	U	---	860	U	---	700	U	---	290	U	---
Pentachlorophenol	360	ug/kg	98	U	---	570	U	---	1400	U	---	1200	U	---	490	U	---
Benzyl Alcohol	57	ug/kg	98	U	---	570	U	---	1400	U	---	1200	U	---	490	U	---
Benzoic Acid	650	ug/kg	200	U	---	1100	U	---	2900	U	---	2300	U	---	980	U	---
Total Organic Carbon	--	mg/kg	5350		---	26400		---	73300		---	57000		---	19800		---

2002 PIPE SEDIMENT

Table C-3. Sediment Sample Semivolatile Organic Compound and Polychlorinated Biphenyls Analytical Results (Page 1 of 3)
Diagonal Storm Drain Cleaning Preparation
Seattle Public Utilities
January/February 2002

Compound	Marine Sediment Quality Standard	Units	Sample Designation																	
			DS-M1-SS			DS-M2a-SS			DS-M2-SS			DS-M3-SS			DS-M4-SS			DS-M5-SS		
			Result (ug/kg)	Q	Result (mg/kg OC)	Result (ug/kg)	Q	Result (mg/kg OC)	Result (ug/kg)	Q	Result (mg/kg OC)	Result (ug/kg)	Q	Result (mg/kg OC)	Result (ug/kg)	Q	Result (mg/kg OC)	Result (ug/kg)	Q	Result (mg/kg OC)
LPAH	370	mg/kg OC	**993**		**262**	**449**		**78**	**843**		**157**	79	U	15	78	U	20	77	U	12
Naphthalene	99	mg/kg OC	78	U	21	78	U	13	79	U	15	79	U	15	78	U	20	77	U	12
Acenaphthylene	66	mg/kg OC	78	U	21	78	U	13	79	U	15	79	U	15	78	U	20	77	U	12
Acenaphthene	16	mg/kg OC	**91**		24	78	U	13	79	U	15	79	U	15	78	U	20	77	U	12
Fluorene	23	mg/kg OC	**92**		24	78	U	13	79	U	15	79	U	15	78	U	20	77	U	12
Phenanthrene	100	mg/kg OC	**660**		**174**	**360**		**62**	**760**		**142**	79	U	15	78	U	20	77	U	12
Anthracene	220	mg/kg OC	**150**		**40**	**89**		**15**	**83**		**15**	79	U	15	78	U	20	77	U	12
2-Methylnaphthalene	38	mg/kg OC	78	U	21	78	U	13	79	U	15	79	U	15	78	U	20	77	U	12
HPAH	960	mg/kg OC	**3460**		**913**	**10190**		**1763**	**3680**		**685**	**578**		**107**	78	U	20	**549**		**87**
Fluoranthene	160	mg/kg OC	**820**		**216**	**900**		**156**	**920**		**171**	**150**		**28**	78	U	20	**130**		**21**
Pyrene	1000	mg/kg OC	**630**		**166**	**810**		**140**	**750**		**140**	**160**		**30**	78	U	20	**130**		**21**
Benzo(a)anthracene	110	mg/kg OC	**340**		**90**	**770**		**133**	**270**		**50**	79	U	15	78	U	20	77	U	12
Chrysene	110	mg/kg OC	**380**		**100**	**1100**		**190**	**410**		**76**	**100**		**19**	78	U	20	**94**		**15**
Benzo(b)fluoranthene	230	mg/kg OC	**300**		**79**	**1500**		**260**	**350**		**65**	**82**		**15**	78	U	20	**110**		**18**
Benzo(k)fluoranthene	230	mg/kg OC	**360**		**95**	**1300**		**225**	**370**		**69**	**86**		**16**	78	U	20	**85**		**14**
Benzo(a)pyrene	99	mg/kg OC	**330**		**87**	**1700**		**294**	**320**		**60**	79	U	15	78	U	20	77	U	12
Indeno(1,2,3,c-d)pyrene	34	mg/kg OC	**160**		**42**	**1000**		**173**	**160**		**30**	79	U	15	78	U	20	77	U	12
Dibenzo(a,h)anthracene	12	mg/kg OC	78	U	21	**210**		**36**	79	U	15	79	U	15	78	U	20	77	U	12
Benzo(g,h,i)perylene	31	mg/kg OC	**140**		**37**	**900**		**156**	**130**		**24**	79	U	15	78	U	20	77	U	12
Total Benzofluoranthenes	230	mg/kg OC	**660**		**174**	**2800**		**484**	**720**		**134**	**168**		**31**	78	U	20	**195**		**31**
1,2-Dichlorobenzene	2.3	mg/kg OC	78	U	20.6	78	U	13.5	79	U	14.7	79	U	14.7	78	U	20.4	77	U	12.3
1,4-Dichlorobenzene	3.1	mg/kg OC	78	U	20.6	78	U	13.5	79	U	14.7	79	U	14.7	78	U	20.4	77	U	12.3
1,2,4-Trichlorobenzene	0.81	mg/kg OC	78	U	20.6	78	U	13.5	79	U	14.7	79	U	14.7	78	U	20.4	77	U	12.3
Hexachlorobenzene	0.38	mg/kg OC	78	U	20.6	78	U	13.5	79	U	14.7	79	U	14.7	78	U	20.4	77	U	12.3
Dimethyl Phthalate	53	mg/kg OC	78	U	21	78	U	13	79	U	15	79	U	15	78	U	20	77	U	12
Diethyl Phthalate	61	mg/kg OC	78	U	21	78	U	13	79	U	15	79	U	15	78	U	20	77	U	12
Di-n-butyl Phthalate	220	mg/kg OC	78	U	21	78	U	13	79	U	15	79	U	15	78	U	20	77	U	12
Butyl Benzyl Phthalate	4.9	mg/kg OC	78	U	20.6	78	U	13.5	79	U	14.7	79	U	14.7	78	U	20.4	77	U	12.3
Bis(2-ethylhexyl)phthalate	47	mg/kg OC	**1000**		**264**	**5100**		**882**	**860**		**160**	**670**		**125**	**330**		**86**	**710**		**113**
Di-n-octyl Phthalate	58	mg/kg OC	78	U	21	**120**		**21**	79	U	15	**130**		**24**	78	U	20	77	U	12
Dibenzofuran	15	mg/kg OC	78	U	21	78	U	13	79	U	15	79	U	15	78	U	20	77	U	12
Hexachlorobutadiene	3.9	mg/kg OC	160	U	42.2	160	U	27.7	160	U	29.8	160	U	29.7	160	U	41.8	150	U	23.9
N-nitrosodiphenylamine	11	mg/kg OC	78	U	21	78	U	13	79	U	15	79	U	15	78	U	20	77	U	12
Aroclor 1016	12	mg/kg OC	62	U	16	61	U	11	63	U	12	60	U	11	59	U	15	56	U	9
Aroclor 1221	12	mg/kg OC	62	U	16	61	U	11	63	U	12	60	U	11	59	U	15	56	U	9
Aroclor 1232	12	mg/kg OC	62	U	16	61	U	11	63	U	12	60	U	11	59	U	15	56	U	9
Aroclor 1242	12	mg/kg OC	62	U	16	61	U	11	63	U	12	60	U	11	59	U	15	56	U	9
Aroclor 1248	12	mg/kg OC	62	U	16	61	U	11	63	U	12	60	U	11	59	U	15	56	U	9
Aroclor 1254	12	mg/kg OC	62	U	16	61	U	11	63	U	12	60	U	11	59	U	15	56	U	9
Aroclor 1260	12	mg/kg OC	62	U	16	61	U	11	63	U	12	60	U	11	59	U	15	56	U	9
Total PCBs	12	mg/kg OC	62	U	16	61	U	11	63	U	12	60	U	11	59	U	15	56	U	9
Phenol	420	ug/kg	160	U	---	160	U	---	160	U	---	160	U	---	160	U	---	150	U	---
2-Methylphenol	63	ug/kg	78	U	---	78	U	---	79	U	---	79	U	---	78	U	---	77	U	---
4-Methylphenol	670	ug/kg	78	U	---	78	U	---	**180**		---	79	U	---	78	U	---	77	U	---
2,4-Dimethylphenol	29	ug/kg	230	U	---	230	U	---	240	U	---	240	U	---	230	U	---	240	U	---
Pentachlorophenol	360	ug/kg	390	U	---	390	U	---	400	U	---	390	U	---	390	U	---	390	U	---
Benzyl Alcohol	57	ug/kg	390	U	---	390	U	---	400	U	---	390	U	---	390	U	---	390	U	---
Benzoic Acid	650	ug/kg	780	U	---	780	U	---	790	U	---	790	U	---	780	U	---	770	U	---
Total Organic Carbon	--	mg/kg	3790		---	5780		---	5370		---	5380		---	3830		---	6280		---

Table C-1. Sediment Sample Petroleum Hydrocarbon and Metals Analytical Results
Diagonal Storm Drain Cleaning Preparation
Seattle Public Utilities
January/February 2002

2002 PIPE SEDIMENT

Constituent	Sediment Quality Standards (mg/kg)	MTCA Method A Soil Cleanup Levels for Unrestricted Uses (mg/kg)	Sample Designation								Duplicate			
			DS-Mout-SS	DS-M1-SS	DS-M2a-SS	DS-M2-SS	DS-M3-SS	DS-M4-SS	DS-M5-SS	DS-T2-SS	DS-T2b-SS	DS-T3a-DS1b-SS	DS-T6b-SS	DS-T8b-SS
			Concentration (mg/kg)											
Gasoline	---	100	NA	ND (25)	ND (24)	ND (25)	ND (24)	ND (24)	ND (22)	ND (24)	ND (320)	ND (470)	ND (290)	ND (270)
Diesel Fuel	---	2,000	NA	77	69	63	82	37	ND (28)	ND (30)	680	6300	ND (180)	ND (170)
Heavy Oil	---	2,000	NA	420	430	560	420	360	470	150	2700	9100	13000	2300
Arsenic	57	20	ND (14)	ND (12)	ND (12)	ND (13)	ND (12)	ND (12)	ND (11)	ND (12)	ND (16)	ND (23)	ND (14)	ND (13)
Barium	---	---	30	19	21	72	24	16	32	99	82	99	110	66
Cadmium	5.1	2	0.91	0.86	0.89	0.85	0.92	ND (0.59)	ND (0.56)	ND (0.60)	1.1	2.8	1.3	1.3
Chromium	260	2,000 (Cr III)	21	29	23	39	23	13	28	25	51	60	37	22
Copper	390	---	38	39	33	43	34	24	160	30	81	280	94	56
Lead	450	250	130	37	33	140	18	47	23	16	130	200	100	120
Mercury	0.41	2	ND (0.34)	ND (0.31)	ND (0.30)	ND (0.31)	ND (0.30)	ND (0.29)	ND (0.28)	ND (0.30)	ND (0.40)	ND (0.58)	ND (0.36)	ND (0.33)
Selenium	---	---	ND (14)	ND (12)	ND (12)	ND (13)	ND (12)	ND (12)	ND (11)	ND (12)	ND (16)	ND (23)	ND (14)	ND (13)
Silver	6.1	---	0.80	ND (0.62)	ND (0.61)	ND (0.63)	ND (0.60)	ND (0.59)	ND (0.56)	ND (0.60)	ND (0.79)	0.79	ND (0.72)	ND (0.67)
Zinc	410	---	220	250	200	240	170	280	130	85	230	460	580	410

Notes: ND = Not Detected at the Practical Quantitation Limit; the PQL is shown in parentheses.
NA = Not Analyzed.
Marine Sediment Quality Standards - Chemical Criteria (WAC 173-204-320).
MTCA Method A Soil Cleanup Levels for Unrestricted Uses (WAC 173-340-740).
Shaded values indicate concentration greater than standards or cleanup level.

1994 Pipe Sediment Samples

Diagonal Storm Drain Pipe Sediment Samples					SQS	CSL
Station	D056-136	D057-088	D056-126	D057-177		
Sample No.	95301	95302	95303	95304		
% Solids	84	24	75	85		
TOC, dry %C	0.24	8.8	1.5	0.37		
Pesticides & PCBs, dry wgt, ug/kg						
4,4'-DDD	<RDL 3.4	19	4	<RDL 3.4		
4,4'-DDE	<RDL 3.4	11	<RDL 3.4	<RDL 3.4		
4,4"-DDT	3.9	18	4.7	<RDL 3.4		
PCB-1248	<RDL 34	190	46	<RDL 34		
Semi-Volatile Organics, dry wgt, mg/kg						
Benz[a]anthracene	<RDL 0.30	<RDL 1.0	<RDL 0.50	<RDL 0.30		
Benzo[b]fluoranthene	0.36	<RDL 1.0	0.57	<RDL 0.30		
Benzo[a]pyrene	<RDL 0.30	<RDL 1.0	<RDL 0.50	<RDL 0.30		
Bis(2-ethylhexyl)phthalate	1.7	11	4.7	<RDL 1.5	1.3	1.9
Butyl benzyl phthalate	<RDL 0.30	<RDL 1.0	0.62	<RDL 0.30		
Chrysene	0.38	<RDL 1.0	0.65	<RDL 0.30		
1,4-Dichlorobenzene	<RDL 0.30	<RDL 1.0	<RDL 0.50	0.33		
Fluoranthene	0.72	<RDL 1.0	1.1	0.52		
4-Methylphenol	<RDL 0.30	9.9	<RDL 0.50	<RDL 0.30		
Phenanthrene	0.46	1.1	0.55	<RDL 0.30		
Pyrene	0.6	<RDL 1.0	1.1	0.45		
Di-n-octyl phthalate	<RDL 0.30	1.3	<RDL 0.50	<RDL 0.30		
4-Methylphenol	<RDL 0.30	9.9	<RDL 0.50	<RDL 0.30		
Metals, dry wgt, mg/kg					mg/Kg DW	
Arsenic	4.3	9	7.3	3.2	93	
Cadmium	0.7	1.1	0.76	0.57	6.7	
Chromium	24	30	14	21	270	
Copper	36	90	51	28	390	
Lead	100	100	120	32	530	
Mercury	0.018	0.12	<RDL 0.01	0.033	0.59	
Silver	0.56	<RDL 0.71	0.67	0.49	6.1	
Zinc	150	320	170	170	960	

Figure 5. City of Seattle Stormdrain Sample Results. (1994)

CITY OF SEATTLE

Diagonal Outfall Sediment samples

April 06, 1995
Produced by the
Seattle Engineering Department,
Geographic Systems

Legend

- Drainage Mainlines
- Culverts
- Sewer Mainlines
- Streams
- D056-126 Sediment sample site (storm drain)

Scale 1" = 500'

1994 Pipe Sediment Sampling locations

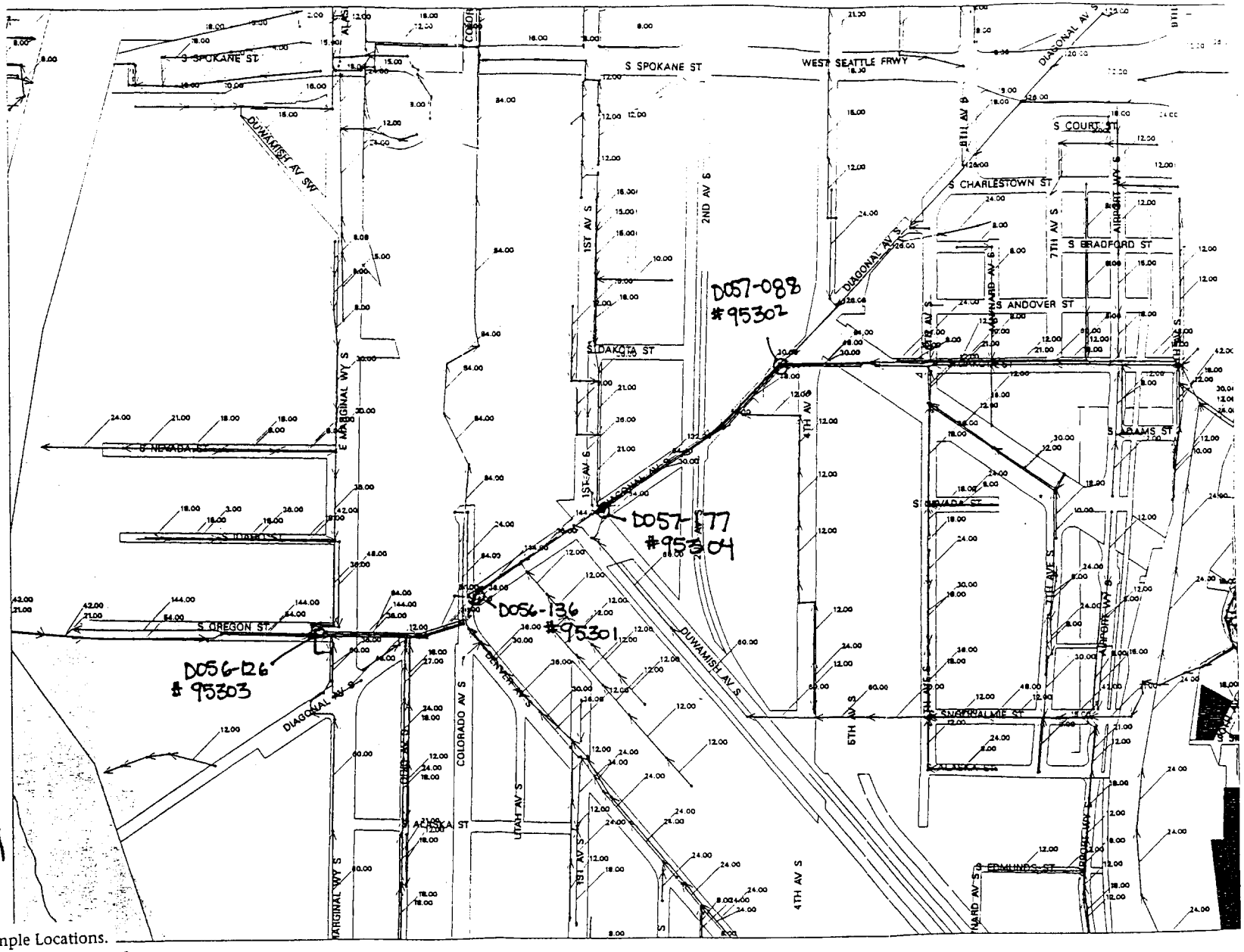


Figure 4. City of Seattle Stormdrain Sample Locations.

1994 pipe sediment

*Contour elevations according to North American Vertical Datum - NAVD88

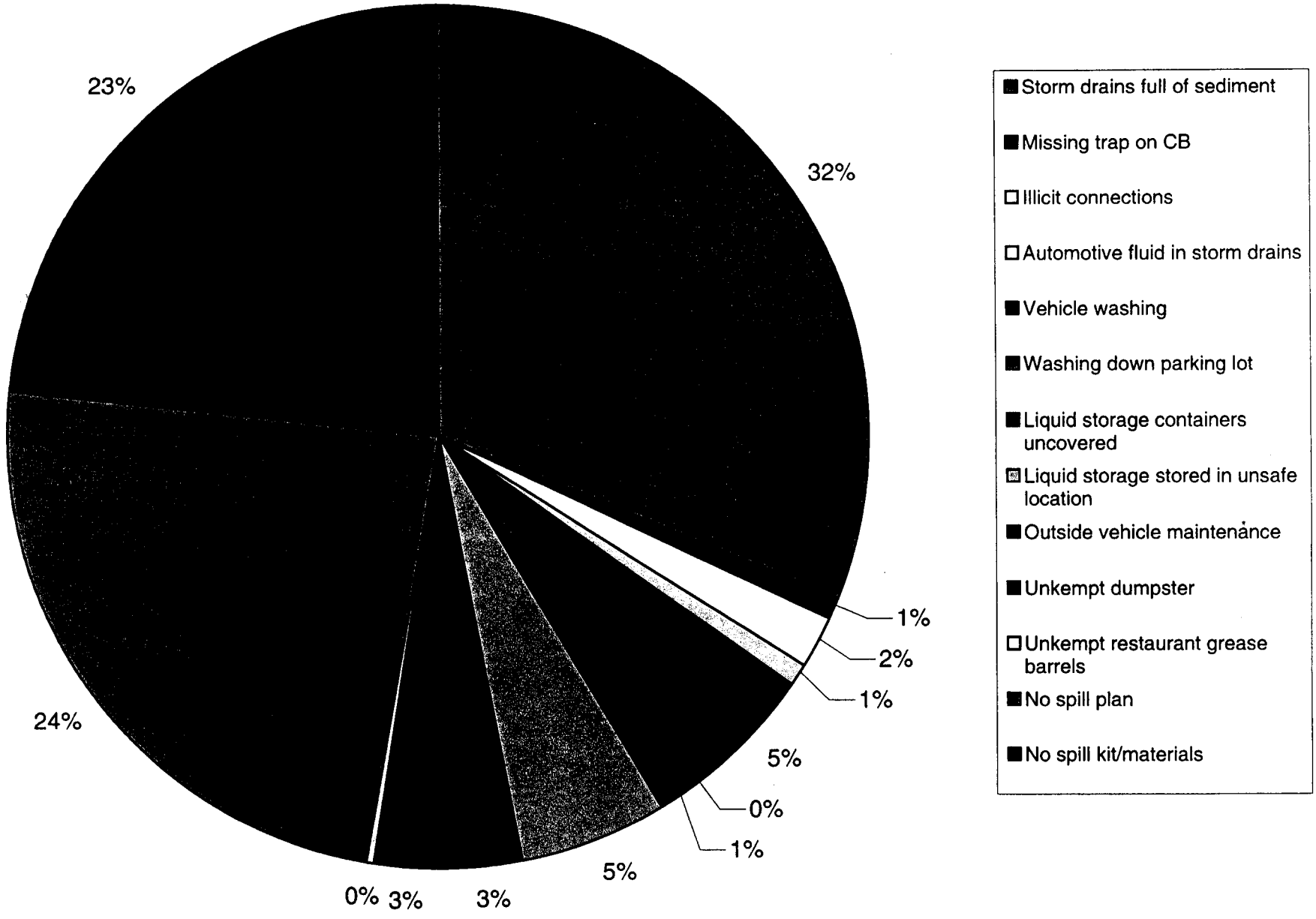


Figure 2: Problems Found During 2001 Business Inspections.

Table 2: Norfolk Business Inspections (2001).

Company	Address	SIC	SIC Description	Drain Type	Basin	Date Inspected	Inspect Type	Problems Found	File Closed (T/F)
AVIATION TRAINING CENT	7201 PERIMETER RD S	8299	Schools and Educational Services, NEC	storm	norfolk		None	FALSE	Open
CARTER RICHARD KEVIN	8500 PERIMETER RD S	8299	Schools and Educational Services, NEC	storm	norfolk		None	FALSE	Open
ROZIER JAMILA L	7149 PERIMETER RD S	8351	Child Day Care Services	storm	norfolk		None	FALSE	Open
TINY TOTS DEVELOPMEN	7201 PERIMETER RD S	8351	Child Day Care Services	storm	norfolk		None	FALSE	Open
PROCTOR JULIANA A	7205 PERIMETER RD S	8351	Child Day Care Services	storm	norfolk		None	FALSE	Open
ROZIER JAMILA L	4614 S COOPER ST	8351	Child Day Care Services	sanitary	norfolk		None	FALSE	Open
TINY TOTS DEVELOPMEN	2832 S OTHELLO ST	8351	Child Day Care Services	sanitary	norfolk		None	FALSE	Open
PROCTOR JULIANA A	2946 S WEBSTER ST	8351	Child Day Care Services	sanitary	norfolk		None	FALSE	Open
MUSEUM OF FLIGHT FOUI	9404 E MARGINAL WY S	8412	Museums and Art Galleries	storm	Outside Basin		None	FALSE	Open
MUSEUM OF FLIGHT FOUI	9404 E MARGINAL WY S	8412	Museums and Art Galleries	storm	Outside City Limits		None	FALSE	Open
KENDRICK MINISTRIES	8535 PERIMETER RD S	8661	Religious Organizations	storm	norfolk		None	FALSE	Open
CHRISTIAN CHURCH OF T	7777 PERIMETER RD S	8661	Religious Organizations	storm	norfolk		None	FALSE	Open
KENDRICK MINISTRIES	10201 BEACON av S	8661	Religious Organizations	sanitary	norfolk		None	FALSE	Open
CHRISTIAN CHURCH OF T	2966 S WEBSTER ST	8661	Religious Organizations	sanitary	norfolk		None	FALSE	Open
PIPING DESIGN SERVICES	7277 PERIMITER RD S	8711	Engineering Services	storm	norfolk		None	FALSE	Open
FORENSIC CONSULTANTS	8500 PERIMETER RD S	8711	Engineering Services	storm	norfolk		None	FALSE	Open
CONTRACT CONTROLLER	8535 PERIMETER RD S	8721	Accounting, Auditing, and Bookkeeping Services	storm	norfolk		None	FALSE	Open
MISTRAL MANAGEMENT C	7149 PERIMETER RD	8811	Private Households	storm	norfolk		None	FALSE	Open
BROWN MICHAEL J	8311 BEACON AV S		#N/A	combined	norfolk		None	FALSE	Open

Table 2: Norfolk Business Inspections (2001).

Company	Address	SIC	SIC Description	Drain Type	Basin	Date Inspected	Inspect Type	Problems Found	File Closed (T/F)
VALLEY LANDSCAPE & DE	9800 40TH AV S	782	Lawn and Garden Services	storm	norfolk		None	FALSE	Open
KUBOTA TOM	4345 S 104TH PL	782	Lawn and Garden Services	storm	norfolk		None	FALSE	Open
ELECCION TEDDY R	4610 S GAZELLE ST	782	Lawn and Garden Services	sanitary	norfolk		None	FALSE	Open
VALLEY LANDSCAPE & DE	9338 39TH AV S	782	Lawn and Garden Services	sanitary	norfolk		None	FALSE	Open
KUBOTA TOM	3932 S PERRY ST	782	Lawn and Garden Services	sanitary	norfolk		None	FALSE	Open
JUAREZ CONSTRUCTION	8013 PERIMETER RD S	1521	General Contractors-Single-Family Houses	storm	norfolk		None	FALSE	Open
JUAREZ CONSTRUCTION	9132 M L KING JR WY S	1521	General Contractors-Single-Family Houses	combined	norfolk		None	FALSE	Open
R L ALIA COMPANY	9215 M L KING JR WY S	1623	Water, Sewer, Pipeline, and Communications and Power Line Construction	sanitary	norfolk		None	FALSE	Open
BACK FORTY INC	7277 PERIMETER RD S	1629	Heavy Construction, NEC	storm	norfolk		None	FALSE	Open
MAO'S PARTNERSHIP	9241 45TH av S	1751	Carpentry Work	storm	norfolk		None	FALSE	Open
OSSES CONTRACTORS IN	10739 47TH av S	1751	Carpentry Work		Outside City Limits		None	FALSE	Open
SORKIN OLEG	8353 BEACON av S	1751	Carpentry Work	combined	norfolk		None	FALSE	Open
LU-BOND CONSTRUCTION	2828 S OTHELLO ST	1761	Roofing, Siding, and Sheet Metal Work	combined	norfolk		None	FALSE	Open
SWAN NET USA LLC	8300 MILITARY RD S	2241	Narrow Fabric and Other Smallware Mills: Cotton, Wool, Silk, and Manmade Fiber	sanitary	norfolk		None	FALSE	Open
THAW CORP	8300 MILITARY RD S	2385	Waterproof Outerwear	storm	norfolk		None	FALSE	Open
JEFFERSON SMURFIT CO	10020 M L KING JR WY S	2631	Paperboard Mills	storm	norfolk		None	FALSE	Open
JEFFERSON SMURFIT CO	9747 M L KING JR WY S	2631	Paperboard Mills	combined	norfolk		None	FALSE	Open
SEATTLE PACKAGING CO	3701 S NORFOLK ST	2653	Corrugated and Solid Fiber Boxes	storm	norfolk		None	FALSE	Open
PACIFIC COATINGS INC	9620 ML KING JR WY S	2951	Asphalt Paving Mixtures and Blocks	storm	norfolk		None	FALSE	Open
PACIFIC COATINGS INC	9243 M L King Jr Wy S	2951	Asphalt Paving Mixtures and Blocks	combined	norfolk		None	FALSE	Open
BOEING COMPANY THE	4340 S 104TH PL	3721	Aircraft	storm	norfolk		None	FALSE	Open
BOEING COMPANY THE	9725 E MARGINAL WY S	3721	Aircraft	storm			None	FALSE	Open
AVIATION PARTNERS INC	8403 PERIMETER RD S	3728	Aircraft Parts and Auxiliary Equipment, NEC	storm	norfolk		None	FALSE	Open
WESTERN METAL PRODU	7696 PERIMETER RD S	3728	Aircraft Parts and Auxiliary Equipment, NEC	storm	norfolk		None	FALSE	Open
WOOLDRIDGE BOATS INC	9844 40TH AV S	3732	Boat Building and Repairing	storm	norfolk		None	FALSE	Open
WOOLDRIDGE BOATS INC	9224 M L KING JR WY S	3732	Boat Building and Repairing	sanitary	norfolk		None	FALSE	Open
TNT UNITED TRUCK LINES	9833 40TH av S	4213	Trucking, Except Local	storm	norfolk		None	FALSE	Open
TNT UNITED TRUCK LINES	9833 40TH av S	4213	Trucking, Except Local	storm	norfolk		None	FALSE	Open
NELSON TRUCKING CO IN	9777 M L KING JR WY S	4214	Local Trucking with Storage	combined	norfolk		None	FALSE	Open
UNITED PARCEL SERVICE	7575 PERIMETER RD S	4215	Courier Services Except by Air	storm	norfolk		None	FALSE	Open
PSCC INC	10404 EMPIRE WY S	4225	General Warehousing and Storage		Outside City Limits		None	FALSE	Open
King County National Airport	7277 Perimeter Rd S	4512	Air Transportation, Scheduled	storm	norfolk		None	FALSE	Open
REED AVIATION INC	8490 PERIMETER RD S	4522	Air Transportation, Nonscheduled	storm	norfolk		None	FALSE	Open
SEATTLE JET SERVICES II	8535 PERIMETER RD S	4522	Air Transportation, Nonscheduled	storm	norfolk		None	FALSE	Open
ERIN AIR INCORPORATED	7149 PERIMETER RD S	4522	Air Transportation, Nonscheduled	storm	norfolk		None	FALSE	Open
AERO COPTERS INC	8535 PERIMETER RD S	4522	Air Transportation, Nonscheduled	storm	norfolk		None	FALSE	Open
Galvin Flying	7023 perimeter rd s	4522	Air Transportation, Nonscheduled	storm	norfolk		None	FALSE	Open
STRAUSS PETER	7575 PERIMETER RD S	4581	Airports, Flying Fields, and Airport Terminal Services	storm	norfolk		None	FALSE	Open

Table 2: Norfolk Business Inspections (2001).

Company	Address	SIC	SIC Description	Drain Type	Basin	Date Inspected	Inspect Type	Problems Found	File Closed (T/F)
R S PACIFIC INC	9840 M L KING JR WY S	1752	Floor Laying and Other Floor Work, NEC	storm	norfolk	06/21/2001	Driveby	FALSE	Closed
Northwest Wrecking	10230 E Marginal Wy S	1795	Wrecking and Demolition Work	storm	Outside Cit	01/31/2002	Driveby	FALSE	Closed
R & M Trucking	9244 m l king jr wy s	4213	Trucking, Except Local	storm	norfolk	06/21/2001	Driveby	FALSE	Closed
Military Flight Center	10002 E Marginal Wy S	4581	Airports, Flying Fields, and Airport Terminal Services	storm	Outside Cit	01/31/2002	Driveby	FALSE	Closed
No name on building	6671 perimeter rd s	4581	Airports, Flying Fields, and Airport Terminal Services	storm	norfolk	09/05/2001	Driveby	FALSE	Closed
No name on building	6691 perimeter rd s	4581	Airports, Flying Fields, and Airport Terminal Services	storm	norfolk	09/05/2001	Driveby	FALSE	Closed
No name on building	6711 perimeter rd s	4581	Airports, Flying Fields, and Airport Terminal Services	storm	norfolk	09/05/2001	Driveby	FALSE	Closed
No name on building	6771 perimeter rd s	4581	Airports, Flying Fields, and Airport Terminal Services	storm	norfolk	09/05/5001	Driveby	FALSE	Closed
No name on building	6771 perimeter rd s	4581	Airports, Flying Fields, and Airport Terminal Services	storm	norfolk	09/05/5001	Driveby	FALSE	Closed
No name on building	6801 perimeter rd s	4581	Airports, Flying Fields, and Airport Terminal Services	storm	norfolk	09/05/5001	Driveby	FALSE	Closed
No name on building	6801 perimeter rd s	4581	Airports, Flying Fields, and Airport Terminal Services	storm	norfolk	09/05/5001	Driveby	FALSE	Closed
NATIONAL AVIATION INC	7170 PERIMETER RD S	5088	Transportation Equipment and Supplies, Except Motor Vehicles	storm	norfolk	09/24/2001	Driveby	FALSE	Closed
INTERCOASTAL INC	8187 PERIMETER RD S	5088	Transportation Equipment and Supplies, Except Motor Vehicles	storm	norfolk	10/12/2001	Driveby	FALSE	Closed
RILU INC (Randy's Restaur	10016 E MARGINAL WY S	5812	Eating and Drinking Places	storm/surfa	norfolk	01/31/2002	Driveby	FALSE	Closed
CREDIT UNION OF THE PA	10200 E MARGINAL WY S	6061	Credit Unions, Federally Chartered	storm	norfolk	01/31/2002	Driveby	FALSE	Closed
BILL PITTMAN JANITORIAL	9242 M L KING JR WY S	7349	Building Cleaning and Maintenance Services, NEC	storm	norfolk	06/21/2001	Driveby	FALSE	Closed
Joe's Auto Service	10300 E Marginal Wy S	7538	General Automotive Repair Shops	storm	Outside Cit	01/31/2002	Driveby	FALSE	Closed
King County Emergency Ma	7300 perimeter rd s	9511	Air and Water Resource and Solid Waste Management	storm	norfolk	09/24/2001	Driveby	FALSE	Closed
No name on building	7201 perimeter rd s		#N/A	storm	norfolk	09/24/2001	Driveby	FALSE	Closed
No name on building	7201 perimeter rd s		#N/A	storm	norfolk	09/24/2001	Driveby	FALSE	Closed
No name on building	8300 military rd s		#N/A	storm	norfolk	06/22/2001	Driveby	FALSE	Closed
No name on building	8300 military rd s		#N/A	storm	norfolk	06/22/2001	Driveby	FALSE	Closed
No name on building	8300 military rd s		#N/A	storm	norfolk	06/22/2001	Driveby	FALSE	Closed
No name on building - vacar	9228 m l king jr wy s		#N/A	storm	norfolk	06/21/2001	Driveby	FALSE	Closed
Frank Coluccio Construction	9850 m l king jr wy s	1610	Heavy construction contractors	storm	norfolk	07/11/2001	Onsite	TRUE	Closed
D A GRAPHICS INC.	9688 M L KING JR WY S	2759	Commercial Printing, NEC	storm	norfolk	06/20/2001	Onsite	TRUE	Open
KAIBAB METALS INC	4357 S 104TH PL	3443	Fabricated Plate Work (Boiler Shops)	storm	norfolk	08/17/2001	Onsite	TRUE	Closed
Encompas	9833 40th av s	3444	Sheet Metal Work	storm	norfolk	6/22/01 & 1(	Onsite	TRUE	Closed
Encompass	3701 S Norfolk ST	3444	Sheet Metal Work	storm	norfolk	6/22/2001 &	Onsite	TRUE	Closed
Hyster Sales Co.	9892 40th av s	3531	Construction Machinery and Equipment	storm	norfolk	07/16/2001	Onsite	TRUE	Closed
FAIRN & SWANSON INC.	9875 40TH AV S	4212	Local Trucking Without Storage	storm	norfolk	06/22/2001	Onsite	TRUE	Closed
UNITED PARCEL SERVICE	7575 perimeter rd s	4212	Local Trucking Without Storage	storm	norfolk	09/26/2001	Onsite	TRUE	Closed

Table 1: Diagonal Basin Business Inspections (as of 3/02).

Company Name	Address	SIC	SIC Description	Drain Type	Basin	Inspection Date	Inspection Type	Problems Found (T/F)	Site Status
PARAGON DISTRIBUTING INC	3232 8TH AV S	5084	Industrial Machinery and Equipment	storm	diag			FALSE	Open
DOUBLE E FOODS LLC	3922 6TH AV S	5141	Groceries, General Line	storm	diag			FALSE	Open
WINNERWAY AMERICAN CORPOF	815 S WELLER ST	5149	Groceries and Related Products, NEC	combined	diag			FALSE	Open
TSUE CHONG CO	3623 6TH AV S	5149	Groceries and Related Products, NEC	storm	diag			FALSE	Open
SKAGIT PETROLEUM	802 S DEARBORN ST	5172	Petroleum and Petroleum Products Wholesalers, Except Bulk Stations and Terminals	combined	diag			FALSE	Open
EVERGREEN WHOLESALE FLORI	3217 AIRPORT WY S	5193	Flowers, Nursery Stock, and Florists' Supplies	combined	diag			FALSE	Open
ACTION FASHIONS	410 8TH AV S	5699	Miscellaneous Apparel and Accessory Stores	combined	diag			FALSE	Open
FARWEST PAPER FLOW INC	3706 AIRPORT WY S	5734	Computer and Computer Software Stores	combined	diag			FALSE	Open
SILVER STREAK SANDWICH EX	3838 4TH AV S	5812	Eating and Drinking Places	storm	diag			FALSE	Open
RISTORANTE MACHIAVELLI	660 S ANDOVER ST	5812	Eating and Drinking Places	combined	diag			FALSE	Open
UGLY MUG CAFE	3707 AIRPORT WY S	5812	Eating and Drinking Places	storm	diag			FALSE	Open
CITY CENTER CARDS & SUNDR	815 S WELLER ST	5947	Gift, Novelty, and Souvenir Shops	combined	diag			FALSE	Open
W H SMITH HOTEL SERVICES	3454 4TH AV S	5947	Gift, Novelty, and Souvenir Shops	combined	diag			FALSE	Open
NORSE IMPORTS	3801 AIRPORT WY S	5947	Gift, Novelty, and Souvenir Shops	combined	diag			FALSE	Open
UNIQUE ART FRAMING	3429 AIRPORT WY S	5999	Miscellaneous Retail Stores, NEC	combined	diag			FALSE	Open
E JAY BOND & ASSOCIATES	3407 AIRPORT WY S	6411	Insurance Agents, Brokers, and Service	storm	diag			FALSE	Open
NORTHGATE CLEANERS	414 8TH AV S	7211	Power Laundries, Family and Commercial	combined	diag			FALSE	Open
AMERICANA PORTRAITS INC	4005 6TH AV S	7221	Photographic Studios, Portrait	storm	diag			FALSE	Open
REPROGRAPHICS NORTHWEST	616 8TH AV S	7334	Photocopying and Duplicating Services	combined	diag			FALSE	Open
CRANE SYSTEMS INC	3614 6TH AV S	7353	Heavy Construction Equipment Rental and Leasing	storm	diag			FALSE	Open
BEXEL CORPORATION	3314 4TH AV S	7359	Equipment Rental and Leasing, NEC	combined	diag			FALSE	Open
ONSITE TECHNICAL SERVICES	1400 AIRPORT WY S	7378	Computer Maintenance and Repair	combined	diag			FALSE	Open
ROSENTHAL GROUP THE INC	3223 6TH AV S	7389	Business Services, NEC	storm	diag			FALSE	Open
JEREVA INC	3619 7TH AV S	7514	Passenger Car Rental	storm	diag			FALSE	Open
SEATTLE PUPPETORY THEATRE	3700 6TH AV S	7929	Bands, Orchestras, Actors, and Other Entertainers and Entertainment Groups	storm	diag			FALSE	Open
GREATER SEATTLE SCCER LE	3613 4TH AV S	7941	Professional Sports Clubs and Promoters	storm	diag			FALSE	Open
RICHARD BENSINGER MD	4000 1ST AV S	8011	Offices and Clinics of Doctors of Medicine	storm	diag			FALSE	Open
PACIFIC MEDICAL CENTER	620 S JACKSON ST	8011	Offices and Clinics of Doctors of Medicine	combined	diag			FALSE	Open
PACIFIC MEDICAL CENTER	620 S JACKSON ST	8011	Offices and Clinics of Doctors of Medicine	combined	diag			FALSE	Open

Table 1: Diagonal Basin Business Inspections (as of 3/02).

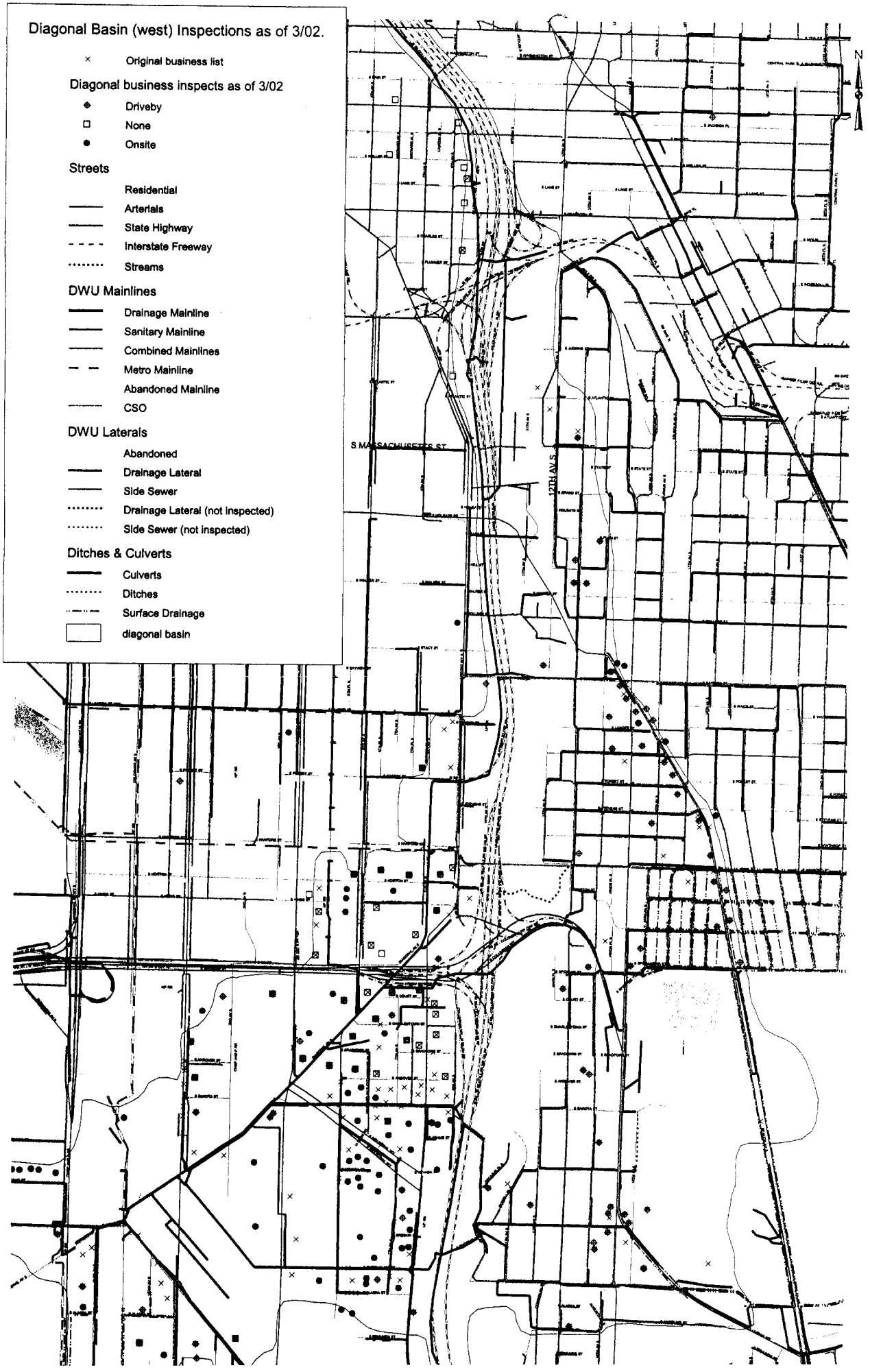
Company Name	Address	SIC	SIC Description	Drain Type	Basin	Inspection Date	Inspection Type	Problems Found (T/F)	Site Status
K & K Inc.	22 S Idaho St	5021	Furniture	storm	diag	02/22/2001	Onsite	FALSE	Closed
George S Schuster Co Inc	12 S Idaho St	5030	Home Furnishings	storm	diag	02/14/2001	Onsite	FALSE	Closed
Precision Welder & Engine Repair	4429 Airport Wy S	5084	Industrial Machinery and Equipment	storm	diag	03/08/2001	Onsite	TRUE	Closed
sea-dru-nar	3844 1st av s	5093	Scrap and Waste Materials	storm	diag	02/13/2001	Onsite	TRUE	Closed
Mallory and Church	676 S Industrial Wy	5136	Men's and Boys' Clothing and Furnishings	storm	diag	05/21/2001	Onsite	TRUE	Closed
Mallory and Church	633 S Snoqualmie St	5136	Men's and Boys' Clothing and Furnishings	storm	diag	06/04/2001	Onsite	TRUE	Closed
Kustom Foods - Seasia	651 S Industrial Wy	5141	Groceries, General Line	storm	diag	05/22/2001	Onsite	TRUE	Closed
Seasia	4601 6th Av S	5142	Packaged Frozen Foods	storm	diag	05/17/2001	Onsite	TRUE	Closed
Plymouth Poultry Company	4500 7th Av S	5144	Poultry and Poultry Products	storm	diag	02/27/2001	Onsite	TRUE	Closed
pacific food inports	2323 airport wy s	5149	Groceries and Related Products, NEC	storm	diag	06/29/2001	Onsite	TRUE	Closed
Western Washinton Beverage	4201 6th Av S	5181	Beer and Ale	storm	diag	05/31/2001	Onsite	TRUE	Closed
General Tool & Supply Company	601 S Alaska St	5251	Hardware Stores	storm	diag	06/07/2001	Onsite	TRUE	Closed
Chemical Distributors, Inc (CDI)	20 S Idaho St	5300	General merchandise stores	storm	diag	02/14/2001	Onsite	FALSE	Closed
the anywear shoe industry	14 S Idaho St	5300	General merchandise stores	storm	diag	02/14/2001	Onsite	FALSE	Closed
cascade designs	4000 1st av s	5300	General merchandise stores	storm	diag	02/13/2001	Onsite	TRUE	Closed
COSTCO WHOLESALE	4401 4TH AV S	5331	Variety Stores	storm	diag	06/20/2001	Onsite	TRUE	Closed
COSTCO WHOLESALE	4401 4TH AV S	5399	Miscellaneous General Merchandise Stores	storm	diag	06/20/2001	Onsite	TRUE	Closed
HILLTOP RED APPLE MARKET	2301 S JACKSON ST	5411	Grocery Stores	Storm	diag	03/09/2001	Onsite	TRUE	Closed
Oversea Casing	601 S Nevada St	5422	Meat and Fish (Seafood) Markets, Including Freezer Provisioners	storm	diag	06/13/2001	Onsite	TRUE	Closed
Borracchini's Fine Foods	619 S Nevada St	5499	Miscellaneous Food Stores	storm	diag	06/13/2001	Onsite	TRUE	Closed
Exxon Self Service Station & Mini Ma	3002 Beacon Ave S	5541	Gasoline Service Stations	Storm	diag	06/21/2001	Onsite	TRUE	Closed
Shell Self Serve & Mini Mart	2415 Beacon Ave S	5541	Gasoline Service Stations	Storm	Lander	03/19/2001	Onsite	TRUE	Closed
Texaco selfservice gas Carwash & m	2424 Beacon Ave S	5541	Gasoline Service Stations	Storm	Lander	03/19/2001	Onsite	TRUE	Closed
ISGOOD WOODWORKS	4660 E MARGINAL WY S	5712	Furniture Stores	storm	diag	06/15/2001	Onsite	TRUE	Closed
PALACE OF CHINA RESTAURAN	2704 BEACON AV S	5812	Eating and Drinking Places	Alley	diag	07/15/2001	Onsite	TRUE	Closed
L.N. Curtis & Sons	629 S Industrial Wy	5999	Miscellaneous Retail Stores, NEC	storm	diag	06/13/2001	Onsite	TRUE	Closed
Key Bank	4323 Airport Wy S	6021	National Commercial Banks	storm	diag	11/06/2001	Onsite	TRUE	Open
Flowserve	615 S Alaska St	7219	Laundry and Garment Services, NEC	storm	diag	05/16/2001	Onsite	TRUE	Closed
ak media/northwest	3601 6th Av S	7336	Commercial Art and Graphic Design	storm	diag	10/12/2000	Onsite	TRUE	Closed
Evergreen Tractor Inc.	720 s forest st	7353	Heavy Construction Equipment Rental and Leasing	storm	diag	05/01/2001	Onsite	TRUE	Open
Totem Equipment Company	5000 E MARGINAL WY S	7353	Heavy Construction Equipment Rental and Leasing	storm	diag	06/14/2001	Onsite	TRUE	Closed
Auto-Chlor	4315 7th Av S	*7359*	Equipment Rental and Leasing, NEC	storm	diag	04/05/2001	Onsite	TRUE	Closed
Global Fulfillment	4-6 S Idaho St	7372	Prepackaged Software	storm	diag	03/29/2001	Onsite	FALSE	Closed
heiser truck bodie,repair & paint	725 s Hanford st	7532	Top, Body, and Upholstery Repair Shops and Paint Shops	combined	diag	02/21/2001	Onsite	TRUE	Closed
safelite auto glass	665 s dakota st	7536	Automotive Glass Replacement Shops	storm	diag	06/06/2001	Onsite	TRUE	Closed

Table 1: Diagonal Basin Business Inspections (as of 3/02).

Company Name	Address	SIC	SIC Description	Drain Type	Basin	Inspection Date	Inspection Type	Problems Found (T/F)	Site Status
BALLARD HEALTH & FITNESS	2415 BEACON AV S	7991	Physical Fitness Facilities		diag	01/10/2001	Driveby	FALSE	Closed
WASHINGTON STATE YOUTH	2025 14TH AV S	7999	Amusement and Recreation	Storm	diag	01/10/2001	Driveby	FALSE	Closed
FCHC INC	4346 15TH AV S	8041	Offices and Clinics of Chiropractors	Storm	diag	01/25/2001	Driveby	FALSE	Closed
GENA C GEE OD	4401 4TH AV S	8042	Offices and Clinics of Optometrists	storm	diag	06/09/2001	Driveby	FALSE	Closed
TIMOTHY BRADBURY	2532 BEACON AV S	8111	Legal Services	Storm	diag	02/15/2001	Driveby	FALSE	Closed
LITIGATION MANAGEMENT CON	3419 16TH AV S	8111	Legal Services	Storm	diag	01/10/2001	Driveby	FALSE	Closed
WASHINGTON ADOPTION REUNI	2821 BEACON AV S	8322	Individual and Family Social Services	Storm	diag	01/28/2001	Driveby	FALSE	Closed
CINDERELLAS DAY CARE	3011 16TH AV S	8351	Child Day Care Services	Storm	diag	01/25/2001	Driveby	FALSE	Closed
WORD XPRESSIONS LEARNING	3438 15TH AV S	8351	Child Day Care Services	Storm	diag	02/15/2001	Driveby	FALSE	Closed
INSTITUTE FOR COMMUNITY L	2113 13TH AV S	8621	Professional Membership	Storm	diag	02/15/2001	Driveby	FALSE	Closed
SEATTLE RETIRED TEACHERS	4337 15TH AV S	8641	Civic, Social, and Fraternal		diag	01/25/2001	Driveby	FALSE	Closed
HICKS & RAGLAND ENGINEERI	3116 13TH AV S	8711	Engineering Services	Storm	diag	01/25/2001	Driveby	FALSE	Closed
KOBAYASHI AND ASSOCIATES	3051 BEACON AV S	8712	Architectural Services		diag	01/25/2001	Driveby	FALSE	Closed
PINNACLE PERFORMANCE INC	4343 15TH AV S	8721	Accounting, Auditing, and		diag	01/25/2001	Driveby	FALSE	Closed
AQUATIC RESEARCH INC	3512 AIRPORT WY S	8731	Commercial Physical and Biological	storm	diag	03/01/2001	Driveby	FALSE	Closed
Frontier-Kemper Construction	4634 E Marginal Wy S	8741	Management Services		diag	01/08/2001	Driveby	FALSE	Closed
AM-ASIA INVESTMENT & CONS	2704 BEACON AV S	8742	Management Consulting Services	Storm	diag	01/25/2001	Driveby	FALSE	Closed
mail handlers incorp	4005 6th av s	8900	Miscellaneous services	storm	diag	02/01/2001	Driveby	FALSE	Closed
BOAS INC	3501 14TH AV S	8999	Services, NEC		diag	01/25/2001	Driveby	FALSE	Closed
King County Sheriff	4623 7th Av S	9221	Police Protection	storm	diag	06/28/2001	Driveby	FALSE	Closed
seattle fire department	3601 2nd av s	9224	Fire Protection	storm	diag	03/23/2001	Driveby	FALSE	Closed
northwest consoladation investors	3828 4th Av S	9800	International Affairs	storm	diag	02/13/2001	Driveby	FALSE	Closed
armadillo machinery corp	3700 6th av s		#N/A	storm	diag	02/01/2001	Driveby	FALSE	Closed
bamboo & wood	3834 4th av s		#N/A	storm	diag	02/13/2001	Driveby	FALSE	Closed
esco industrial service center	3844 1st av s		#N/A	storm	diag	02/13/2001	Driveby	FALSE	Closed
VACANT	4323 Airport Wy S		#N/A	storm	diag	06/28/2001	Driveby	FALSE	Closed
Vacant service4 station/ deli			#N/A	storm	diag	06/09/2001	Driveby	FALSE	Closed
Vacant service4 station/ deli			#N/A	storm	diag	06/09/2001	Driveby	FALSE	Closed
Vacant warehouse			#N/A	storm	diag	06/09/2001	Driveby	FALSE	Closed
the bentley company	4109 airport wy s	782	Lawn and Garden Services	storm	diag	06/06/2001	Onsite	TRUE	Closed
SPU - Sunny Jim	4200 Airport Wy S	1611	Highway and Street Construction, Except Elevated Highways		diag	09/18/2001	Onsite	TRUE	Open
Washington Belt & Drive Systems	4201 Airport Wy S	1796	Installation or Erection of Building Equipment, NEC	storm	diag	03/08/2001	Onsite	TRUE	Closed
John Latta Associates	4621 Airport Wy S	1799	Special Trade Contractors, NEC	storm	diag	02/26/2001	Onsite	TRUE	Closed
Schwartz Bakery	617 S Nevada St	2051	Bread and Other Bakery Products, Except Cookies and Crackers	storm	diag	05/24/2001	Onsite	TRUE	Closed
banzai sushi	3922 6th av s	2099	Food Preparations, NEC	storm	diag	06/27/2001	Onsite	TRUE	Closed
Atlas Imports Inc.	4105-4107 Airport Wy S	2261	Finishers of Broadwoven Fabrics of Cotton	storm	diag	03/20/2001	Onsite	TRUE	Closed
NorthWest Dyeworks Inc.	4505 Airport Wy S	2261	Finishers of Broadwoven Fabrics of Cotton		diag	02/20/2001	Onsite	FALSE	Closed

Table 1: Diagonal Basin Business Inspections (as of 3/02).

Company Name	Address	SIC	SIC Description	Drain Type	Basin	Inspection Date	Inspection Type	Problems Found (T/F)	Site Status
HUI INTERTRADING	2503 BEACON AV S	0	#N/A	Storm	Maybe Rai	01/25/2001	Driveby	FALSE	Closed
ANDREW MIDDLEBROOKS FORGI	4512 14TH AV S	0	#N/A	Storm	diag	02/08/2001	Driveby	FALSE	Closed
ANDREW MIDDLEBROOKS FORGI	4512 14TH AV S	0	#N/A	Storm	diag	02/15/2001	Driveby	FALSE	Closed
NS INC	4341 15TH AV S	0	#N/A	Storm	diag	01/25/2001	Driveby	FALSE	Closed
SCENIC LANDSCAPE COMPANY	2720 14TH AV S	782	Lawn and Garden Services	Storm	diag	01/10/2001	Driveby	FALSE	Closed
DOUG DAY GARDENING & LAND	4522 14TH AV S	782	Lawn and Garden Services	Storm	diag	02/22/2001	Driveby	FALSE	Closed
G W CONSTRUCTORS	2519 15TH AV S	1521	General Contractors-Single-Family		diag	02/08/2001	Driveby	FALSE	Closed
JAY ROBERTS CONST	2805 BEACON AV S	1521	General Contractors-Single-Family	Storm	diag	02/15/2001	Driveby	FALSE	Closed
Aspen Development Corporation	4126 Airport Wy S	1521	General Contractors-Single-Family		diag	01/05/2001	Driveby	FALSE	Closed
Aspen Homes Inc.	4126 Airport Wy S	1522	General Contractors-Residential		diag	01/05/2001	Driveby	FALSE	Closed
CHAI TAI INVESTMENTS INC	4362 15TH AV S	1542	General Contractors-Nonresidential	Storm	diag	01/22/2001	Driveby	FALSE	Closed
PUGET SUND DREDGING CO	1308 S ANGELINE ST	1629	Heavy Construction, NEC	Storm	diag	01/25/2001	Driveby	FALSE	Closed
GOLDEN N INC	2351 12TH AV S	1721	Painting and Paper Hanging	Storm	diag	01/28/2001	Driveby	FALSE	Closed
NEW FINISHES	4786 1ST AV S	1721	Painting and Paper Hanging	storm	diag	06/08/2001	Driveby	FALSE	Closed
VERTIGO HIGH ACCESS SERVI	2021 13TH AV S	1751	Carpentry Work	Storm	diag	02/08/2001	Driveby	FALSE	Closed
HONG DE REMODELING CO.	4132 14TH AV S	1751	Carpentry Work	Storm	diag	02/15/2001	Driveby	FALSE	Closed
CNA CUSTOM HOME DESIGN IN	3919 14TH AV S	1751	Carpentry Work		diag	01/22/2001	Driveby	FALSE	Closed
WILLOTT SEATTLE ENTERPRIS	4798 1ST AV S	1752	Floor Laying and Other Floor Work,	comb	diag	06/09/2001	Driveby	FALSE	Closed
JOHNSON ROOFING & GUTTERS	4100 1ST AV S	1761	Roofing, Siding, and Sheet Metal	storm	diag	06/08/2001	Driveby	FALSE	Closed
DEMOLITION MAN INC	4101 4TH AV S	1795	Wrecking and Demolition Work	storm	diag	06/08/2001	Driveby	FALSE	Closed
C & C MEATS	3922 6TH AV S	2092	Prepared Fresh or Frozen Fish and	storm	diag	06/01/2001	Driveby	FALSE	Closed
BOOJUM WOODWORKS	4268 10TH AV S	2517	Wood Television, Radio, Phonograph	Storm	diag	01/10/2001	Driveby	FALSE	Closed
ADVANTAGE LIMB SYSTEMS IN	4501 15TH AV S	3089	Plastics Products, NEC	Storm	diag	02/08/2001	Driveby	FALSE	Closed
OUTCAST & COMPANY	3915 14TH AV S	3369	Nonferrous Foundries, Except	Storm	diag	02/22/2001	Driveby	FALSE	Closed
Seattle Barrel Company	4716 Airport Wy S	3412	Metal Shipping Barrels, Drums,		diag	09/17/2001	Driveby	FALSE	Closed
bloch steel Incorp.	4580 colorado av s	3444	Sheet Metal Work		diag	06/06/2001	Driveby	FALSE	Closed
alaskan copper & brass	4700 colorado av s	3549	Metalworking Machinery, NEC	combined	diag	06/06/2001	Driveby	FALSE	Closed
FLEETPRIDE	5400 2ND AV S	3714	Motor Vehicle Parts and Accessories	comb	diag	06/09/2001	Driveby	FALSE	Closed
SEATTLE CYCLE CENTER INC	3320 BEACON AV S	3751	Motorcycles, Bicycles, and Parts		diag	01/25/2001	Driveby	FALSE	Closed
EVERGREEN TOWNCAR SERVICE	4337 12TH AV S	4111	Local and Suburban Transit	Storm	diag	01/25/2001	Driveby	FALSE	Closed
TRE TRUCKING INC.	1541 13TH AV S	4212	Local Trucking Without Storage	Storm	diag	01/22/2001	Driveby	FALSE	Closed
owl transfer co.	3623 6th av s	4213	Trucking, Except Local	storm	diag	02/01/2001	Driveby	FALSE	Closed
I & w food corp	923 s bayview st	4225	General Warehousing and Storage	storm	diag	05/01/2001	Driveby	FALSE	Closed
seattle public utilities paint shop	3641 2nd av s	4225	General Warehousing and Storage	storm	diag	03/23/2001	Driveby	FALSE	Closed
LAKE CITY TRAVEL	2800 16TH AV S	4724	Travel Agencies		diag	01/25/2001	Driveby	FALSE	Closed
HUSKY INTERNATIONAL TRUCK	4786 1ST AV S	5012	Automobiles and Other Motor	storm	diag	06/09/2001	Driveby	FALSE	Closed
HUSKY INTERNATIONAL TRUCK	4786 1ST AV S	5012	Automobiles and Other Motor	storm	diag	06/09/2001	Driveby	FALSE	Closed
SKW MASTER BUILDERS INC	4501 E MARGINAL WY S	5039	Construction Materials, NEC	storm	diag	06/09/2001	Driveby	FALSE	Closed
FLICKER FORGE	4512 14TH AV S	5039	Construction Materials, NEC	Storm	diag	01/28/2001	Driveby	FALSE	Closed
ISLAND CORPORATION INC	2704 BEACON AV S	5045	Computers and Computer Peripheral	Storm	diag	01/22/2001	Driveby	FALSE	Closed


Diagonal Basin (west) Inspections as of 3/02.
Original business list
Diagonal business inspects as of 3/02
Driveby
None
Onsite
Streets
Residential
Arterials
State Highway
Interstate Freeway
Streams
DWU Mainlines
Drainage Mainline
Sanitary Mainline
Combined Mainlines
Metro Mainline
Abandoned Mainline
CSO
DWU Laterals
Abandoned
Drainage Lateral
Side Sewer
Drainage Lateral (not inspected)
Side Sewer (not inspected)
Ditches & Culverts
Culverts
Ditches
Surface Drainage
diagonal basin
S MASSACHUSETTS ST
10TH AVE S
N

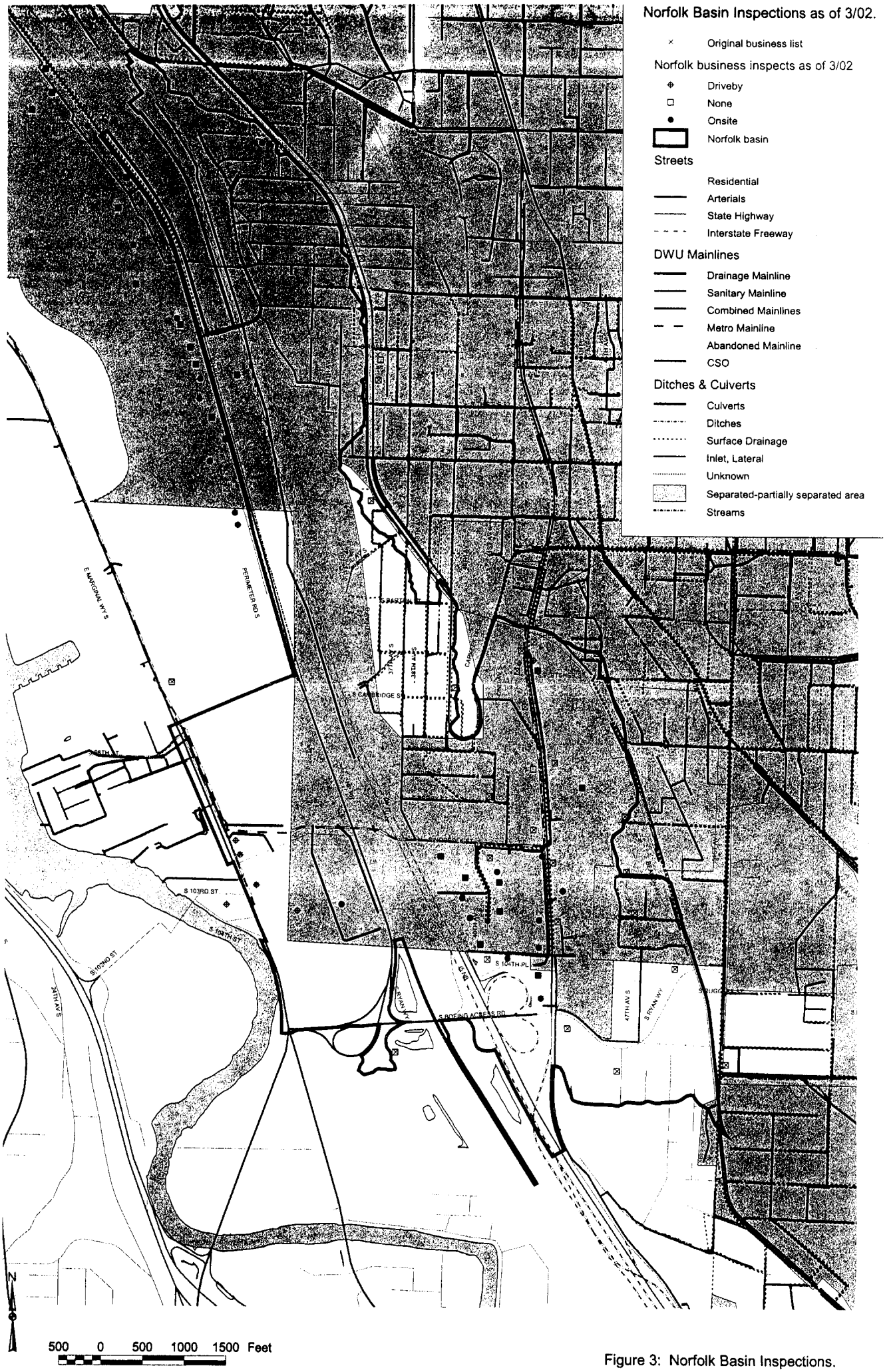


Figure 3: Norfolk Basin Inspections.

Business inspections focus on outdoor activities to minimize the presence of onsite pollutants that could come in contact with stormwater runoff. Specific requirements for operational and structural controls are described in the City's 2000 Source Control Technical Requirements Manual.

In 2001, 200 businesses were inspected in the western portion of the Diagonal basin (109 drive-by inspections and 91 complete onsite inspections). A list of businesses inspected is provided in Table 1 and a map of the business locations is provided in Figure 1. A total of 81 of the businesses inspected were not in compliance with City stormwater source control requirements. As shown in Figure 2, most of the problems were related to inadequate maintenance of onsite storm drainage systems (33 percent) and inadequate spill response programs (47 percent). SPU inspectors worked with the business owners to improve their stormwater pollution prevention practices. As of March 2002, over 90 percent of the businesses inspected are now in compliance with City stormwater requirements.

Norfolk Basin Business Inspections

In 2001, 68 businesses operating in the Norfolk basin were inspected (24 drive-by and 44 onsite inspections). See Table 2 and Figure 3 for a list of the businesses inspected and map of business locations. A total of 68 of the businesses were not in compliance with City stormwater source control requirements. As of March 2002, over 95 percent of the businesses inspected are now in compliance with City stormwater requirements.

Future Plans

In 2002-2003, the SPU surface water quality team will continue conducting source control activities in the Diagonal basin to support the early action cleanup proposed for the Duwamish/Diagonal CSO/SD as part of the lower Duwamish Superfund investigation. An additional inspector will be hired in 2002, who will be assigned primarily to the SPU Duwamish source control effort. Pollutant source inspections will be expanded to cover the eastern portion of the drainage basin that was not covered in 2001. In addition, focused inspections will be conducted at select businesses in the basin to determine whether these facilities are sources of the contaminants of concern (COC) found in the sediment offshore of the Diagonal outfall. These additional inspections will likely include sampling of onsite catch basins to confirm the presence of waterway COCs and may include installation of in-line sediment traps to aid in source tracing efforts in the basin. Additional investigation and sampling may be required to support modeling efforts and recontamination evaluations that will likely be conducted as part of the cleanup study.

Inspections and source identification/control efforts will also likely be initiated in the South Park drainage basin to coincide with a hydrologic/hydraulic basin plan that is currently being conducted in that basin. The South Park basin discharges to the Duwamish River on the west bank at approximately 7th Avenue S.

Memorandum

To	Nancy Ahern
CC:	Rich Gustav, Martin Baker, Marya Silvernale, Bob Chandler, Martha Burke
From	Beth Schmoyer
Date	March 25, 2002
Subject	Status of stormwater pollutant source investigations in lower Duwamish area.

In response to the March 19 meeting concerning the lower Duwamish River Superfund investigation, I have put together a brief summary of pollution source control efforts completed by the surface water quality team as of March 2002. To date, the team has focused on conducting business inspections in the Diagonal Avenue S and Norfolk storm drain basins. In addition, our team along with the SPU hazardous materials team and drainage/wastewater operations (DWW) have responded to 2 reported spills at the Diagonal outfall.

Diagonal Avenue S Storm Drain Spills

On November 8, 1999, the U.S. Coast Guard observed a large oil sheen in the Duwamish River near the outfall from the City of Seattle storm drain at Diagonal Avenue S extending as far as the mouth of the river at Elliott Bay. Other users of the Duwamish River claimed impacts from the oil sheen, including a nearby marina owned by the Muckleshoot Tribe. On January 18, 2000, the Coast Guard issued a Notice of Federal Interest and a Notice of Violation (NOV) against the City of Seattle; the NOV was later dropped. On February 14, 2000, the City installed a temporary containment boom and absorbent boom offshore of the outfall to capture oil discharged from the storm drain. In addition, City staff began to observe the conditions at the outfall on a daily basis to determine the extent and severity of the oily discharge. Observations indicated that oil was consistently present in the discharge from the Diagonal drain, but never again approaching the magnitude of the November 8 spill. Daily observations continued through 2000 and were changed to weekly inspections in 2001. The internal absorbent boom continues to be replaced as needed (about every 2-3 months) and was last replaced on February 21, 2002.

Although a specific source of the November 8 spill has not been clearly identified, the following two possible sources of petroleum hydrocarbons were found in the basin:

- In September 2000, DWW crews removed approximately 6,500 gallons of oil-contaminated material from a storm drain at 7th Avenue S and S. Charlestown Street. Attempts to video-inspect the drain were unsuccessful due to a blockage in the line east of 7th Ave S. Runoff from this system discharges to a small unpaved area located on southwest corner of S. Charlestown St. and 7th Avenue S. During large storm events, this area could overflow to the Diagonal Avenue S. storm drain system.

- In July 2000, King County notified SPU of a groundwater contamination problem in the vicinity of the Diagonal storm drain at Denver Avenue S. and Diagonal Avenue S (about 0.5 miles inland of the outfall at the river). Union Pacific Railroad was conducting a groundwater pump and treat operation to

Quality Assurance Review for Duwamish Estuary/Elliott Bay Miscellaneous (Crab, Mussels, and Prawns) Tissue Study (Report), December 30, 1997

Quality Assurance Review for Duwamish Estuary Transplanted Mussel Study (Report), February 12, 1997

Quality Assurance Review for Duwamish Estuary Transplanted Mussel Study II (Report), October 27, 1997

Review of Quality Control Data for Potential Method Detection Limit Adjustments for Tissue, (Technical Memorandum), November 10, 1997

Inventory of King County Data
Brandon Street CSO

Sediment Chemistry

		Number of Samples												
Study	**Year**	**Ammonia**	**BNAs**	**Butyltin**	**Mercury**	**Metals**	**Methyl Hg**	**PCBs**	**Pesticides**	**PSD**	**Solids**	**Sulfides**	**TOC**	**Volatiles**
NPDES CSO Sediment Baseline Study (1 grab)	1990	0	1	0	1	1	0	1	1	0	1	1	1	0
EB/DRP CSO Sediment Baseline Study (4 grabs)	1992	0	4	0	4	4	0	4	4	0	4	0	4	4
CSO Water Quality Assessment (17 grabs)	1997	17	12	13	17	17	17	12	0	17	17	17	17	0

CSO Effluent Chemistry and Microbiology

		Number of Samples														
Study	**Year**	**Ammonia**	**BNAs**	**Conductivity**	**Demands**	**Fec. Coliform**	**Hardness**	**Mercury**	**Metals**	**Microtox**	**Nitrate/Nitrite**	**PCBs**	**Pesticides**	**pH**	**Solids**	**Temperature**
NPDES CSO Baseline Monitoring	1990	0	1	0	4	4	0	4	4	0	0	4	4	0	4	0
CSO Water Quality Assessment	1996-97	34	31	58	35	35	34	89	81	105	16	10	9	57	71	59

Receiving Water Chemistry and Microbiology

		Number of Samples														
Study	**Year**	**Ammonia**	**BNAs**	**Conductivity**	**Diss. Oxygen**	**Demands**	**Fec. Coliform**	**Hardness**	**Mercury**	**Metals**	**Nitrate/Nitrite**	**PCBs**	**Pesticides**	**pH**	**Solids**	**Temperature**
CSO Water Quality Assessment	1996-97	192	36	216	120	6	192	6	24	244	132	2	2	192	384	216

Tissue Chemistry

		Number of Samples							
Study	**Year**	**BNAs**	**Butyltin**	**Lipids**	**Mercury**	**Metals**	**PCBs**	**Pesticides**	**Solids**
CSO Water Quality Assessment (Total Samples)	1996-97	29	29	29	29	29	29	9	11
Dungeness Crab	1997	2	2	2	2	2	2	0	2
English Sole	1997	6	6	6	6	6	6	0	6
Shiner Perch	1997	3	3	3	3	3	3	0	3
Transplanted Mussels (dry season)	1996	6	6	6	6	6	6	6	0
Transplanted Mussels (wet season)	1997	6	6	6	6	6	6	0	0
Wild Mussels (dry season)	1996	3	3	3	3	3	3	3	0
Wild Mussels (wet season)	1997	3	3	3	3	3	3	0	0

Specialized Sampling

Semipermeable membrane devices (SPMD) were deployed in April, 1997, at two depths near the Brandon Street CSO outfall in association with the CSO Water Quality Assessment. The SPMD were analyzed for polynuclear aromatic hydrocarbon compounds, PCBs (Aroclors and congeners), and chlorinated pesticides.

Notes

CSO - Combined Sewer Overflow
BNAs - Base/Neutral/Acid Exctractable Semivolatile Compounds
Methyl Hg - Methyl Mercury
PCBs - Polychlorinated Biphenyls
PSD - Particle Size Distribution (Grain Size)
TOC - Total Organic Carbon
NPDES - National Pollutant Discharge Elimination System

Inventory of King County Data
Chelan Avenue CSO

Sediment Chemistry

		Number of Samples											
Study	**Year**	**Ammonia**	**AVS/SEM**	**BNAs**	**Butyltin**	**Mercury**	**Metals**	**PCBs**	**Pesticides**	**PSD**	**Solids**	**Sulfides**	**TOC**
NPDES CSO Baseline Sediment Study (6 grabs)	1995	6	1	6	0	6	6	6	6	6	6	6	6
EB/DRP Chelan Storm Drain Sediment Study (3 grabs)	1995	0	0	3	3	3	3	3	3	3	3	0	3
NPDES CSO Baseline Sediment Study (2 grabs)	1996	0	0	2	0	2	2	2	0	2	2	0	2

Sediment Bioassays

		Number of Samples		
Study	**Year**	**Amphipod**	**Echinoderm**	**Polychaete**
NPDES CSO Baseline Sediment Study (5 grabs)	1996	5	5	5

CSO Effluent Chemistry and Microbiology

		Number of Samples													
Study	**Year**	**Ammonia**	**BNAs**	**Conductivity**	**Demands**	**Fec. Coliform**	**Hardness**	**Mercury**	**Metals**	**Microtox**	**Nitrate/Nitrite**	**PCBs**	**Pesticides**	**pH**	**Solids**
NPDES CSO Baseline Monitoring	1994-95	0	1	0	3	3	0	3	3	0	0	1	1	0	3
CSO Water Quality Assessment	1996-97	22	22	23	22	22	23	23	23	22	12	1	1	23	38

Receiving Water Chemistry and Microbiology

		Number of Samples										
Study	**Year**	**Ammonia**	**BNAs**	**Conductivity**	**Diss. Oxygen**	**Fec. Coliform**	**Mercury**	**Metals**	**Nitrate/Nitrite**	**pH**	**Solids**	**Temperature**
Stream Monitoring Station 0305	1988-2001	204	0	204	274	202	0	0	203	204	204	202
CSO Water Quality Assessment	1996-97	192	42	234	120	192	121	234	22	192	192	240

Current Meters

An accoustic doppler velocity profiler (ADVP) current meter was deployed in the vicinity of the Chelan Avenue CSO for a period of 12 months from August, 1996 to August, 1997, in association with the CSO Water Quality Assessment.

Hydrolab® Datasondes

Three Hydrolab® Datasondes were deployed in the vicinity of the Chelan Avenue CSO to collect salinity, temperature, turbidity, and depth data for a period of 12 months from August, 1996 to August, 1997, in association with the CSO Water Quality Assessment.

Notes

CSO - Combined Sewer Overflow
AVS/SEM - Acid Volatile Sulfides/Simultaneously Extractable Metals
BNAs - Base/Neutral/Acid Exctractable Semivolatile Compounds
PCBs - Polychlorinated Biphenyls
PSD - Particle Size Distribution (Grain Size)
TOC - Total Organic Carbon
NPDES - National Pollutant Discharge Elimination System

Inventory of King County Data
Hanford Street CSO

Sediment Chemistry

		Number of Samples										
Study	**Year**	**Ammonia**	**AVS/SEM**	**BNAs**	**Mercury**	**Metals**	**PCBs**	**Pesticides**	**PSD**	**Solids**	**Sulfides**	**TOC**
NPDES CSO Baseline Sediment Study (7 grabs)	1995	7	1	7	7	7	7	7	7	7	7	7
NPDES CSO Baseline Sediment Study (3 grabs)	1996	0	0	3	3	3	3	0	3	3	0	3

Sediment Bioassays

		Number of Samples		
Study	**Year**	**Amphipod**	**Echinoderm**	**Polychaete**
NPDES CSO Baseline Sediment Study (6 grabs)	1996	6	6	6

CSO Effluent Chemistry and Microbiology

		Number of Samples														
Study	**Year**	**Ammonia**	**BNAs**	**Conductivity**	**Demands**	**Fec. Coliform**	**Hardness**	**Mercury**	**Metals**	**Microtox**	**Nitrate/Nitrite**	**PCBs**	**Pesticides**	**pH**	**Solids**	**Temperature**
CSO Water Quality Assessment	1996-97	24	24	35	29	20	24	57	63	99	13	6	6	35	62	39

Receiving Water Chemistry and Microbiology

		Number of Samples										
Study	**Year**	**Ammonia**	**BNAs**	**Conductivity**	**Diss. Oxygen**	**Fec. Coliform**	**Mercury**	**Metals**	**Nitrate/Nitrite**	**pH**	**Solids**	**Temperature**
CSO Water Quality Assessment	1996-97	192	42	192	120	192	24	234	132	192	384	192

Tissue Chemistry

		Number of Samples						
Study	**Year**	**BNAs**	**Butyltin**	**Lipids**	**Mercury**	**Metals**	**PCBs**	**Pesticides**
CSO Water Quality Assessment (Total Samples)	1996-97	6	6	6	6	6	6	3
Wild Mussels (dry season)	1996	3	3	3	3	3	3	3
Wild Mussels (wet season)	1997	3	3	3	3	3	3	0

Notes

CSO - Combined Sewer Overflow
AVS/SEM - Acid Volatile Sulfides/Simultaneously Extractable Metals
BNAs - Base/Neutral/Acid Exctractable Semivolatile Compounds
PCBs - Polychlorinated Biphenyls
PSD - Particle Size Distribution (Grain Size)
TOC - Total Organic Carbon
NPDES - National Pollutant Discharge Elimination System

Inventory of King County Data
King Street CSO

Sediment Chemistry

		Number of Samples				
Study	**Year**	**BNAs**	**Mercury**	**Metals**	**PCBs**	**Solids**
NPDES CSO Sediment Baseline Study (6 grabs)	1988	5	6	6	5	6

CSO Effluent Chemistry and Microbiology

		Number of Samples														
Study	**Year**	**Ammonia**	**BNAs**	**Conductivity**	**Demands**	**Fec. Coliform**	**Hardness**	**Mercury**	**Metals**	**Microtox**	**Nitrate/Nitrite**	**PCBs**	**Pesticides**	**pH**	**Solids**	**Temperature**
CSO Water Quality Assessment	1996-97	22	22	23	22	18	23	46	46	78	14	7	4	23	47	29

Receiving Water Chemistry and Microbiology

		Number of Samples						
Study	**Year**	**Ammonia**	**Fec. Coliform**	**Nitrate/Nitrite**	**Phosphorus**	**Salinity**	**Silica**	**Temperature**
Beach Monitoring Station LTEH02	1988-98	37	163	37	37	32	37	159

Tissue Chemistry

		Number of Samples						
Study	**Year**	**BNAs**	**Butyltin**	**Lipids**	**Mercury**	**Metals**	**PCBs**	**Solids**
CSO Water Quality Assessment	1997	1	1	1	1	1	1	1

Notes

CSO - Combined Sewer Overflow
BNAs - Base/Neutral/Acid Exctractable Semivolatile Compounds
PCBs - Polychlorinated Biphenyls

1995

		STORMWATER SAMPLES												
		L6478-1	L6744-1	L6714-1	L6744-2	L7049-1	L7074-1	L7133-1	L7204-1	L7300-1	L7300-2		B&C*	B&C*
	model input	9-Jul	16-Aug	11-Aug	16-Aug	27-Sep	2-Oct	10-Oct	20-Oct	8-Nov	8-Nov	Sample	Comm/Ind /Hghwy Avg	All uses avg
	ug/l	hinds	hinds	horton	horton	horton	horton	horton	horton	hinds	horton	avg	1974-81	1986-88
Arsenic	9.52	3.05	3.11	1.6	3.4	3.71	3.37	1.9	2.24	2.83	2.26	2.75		
Cadmium	1.46	0.1	0.46	0.49	0.61	0.8	0.78	0.33	0.4	0.9	0.61	0.55	2.3	0.8
Chromium	13.47	22	3.3	5.9	4.49	5.75	6.01	2.13	2.2	17	3.5	7.23		6.2
Copper	43.6	119	41.1	33.8	34.3	54.2	31.8	20.7	20.7	75.4	39	47.00	99	31
Lead	65.87	63.4	21.7	8.51	44.1	68.1	61.3	18.3	30.2	42.5	34.8	39.29	377	57
Mercury	0.31	0.1	0.1	0.1	0.32	0.1	0.1	0.1	0.1	0.1	0.1	0.12		
Nickel	12.34	34	6.28	12.7	6.89	7.82	6.5	2.96	4.37	26.1	4.15	11.18		
Silver	2.74					0	0	0	0			0.00		
Zinc	178.8	308	79.2	215	104	135	130	49.8	94.5	255	81.4	145.19	259	117
Butyl	2.2	0.79	0.29	0.29	0.92	0.84	0.29	0.29	0.987	0.29	0.9	0.59		
Bis(2-ethyl)	9.45	6.07	10.1	7	7.09	6.75	5.17	14.7	0.29	3.48	8.11	7.15		
xxx	Shaded cell reported as <MDL, assigned 0.5xMDL for average calculations.													
B&C*	Analysis of Stormwater Monitoring Data, 1989, Steve Merrill													

	Water Quality Criteria (µg/L)[1]			
	Fresh[2]		Marine	
	Acute	Chronic	Acute	Chronic
Arsenic	360	190	69	36
Cadmium	0.54	0.28	42	9.4
Chromium	129	42	-	-
Copper	3.2	2.5	5.8	3.7
Lead	9.0	0.35	221	8.5
Mercury	2.1	0.012	2.1	0.025
Nickel	316	35	75	8.3
Silver	0.16	-	2.2	-
Zinc	26	23	95	86

[1]Criteria based on total metals.
[2]Fresh water criteria based on hardness of 17 mg $CaCO^3$/L.

- Fails CSL (WAC 173-204-520). The test sediment has a significantly higher ($P \leq 0.05$) mean mortality than the reference sediment, and the test sediment mean mortality is 30 percent greater than the reference sediment.

Amphipod bioassay results are summarized in **Table 4.8**. Station DUD204 was the only station to exceed SMS biological criteria.

4.6.2 Echinoderm Larval Bioassay

The sediment larval test using the echinoderm *Dendraster excentricus* was conducted for seven test sediments, two reference sediments, two control sediments, and one seawater control. The seawater control met the applicable SMS performance criteria for the echinoderm test. SMS interpretive results were determined using the following SMS biological effects criteria:

- Fails SQS (WAC 173-204-320). The test sediment has a combined abnormality and mortality that is more than 15 percent greater than the reference sediment, and the difference is statistically significant ($P \leq 0.10$).

- Fails CSL (WAC 173-204-520). The test sediment has a combined abnormality and mortality that is more than 30 percent greater than the reference sediment, and the difference is statistically significant ($P \leq 0.10$).

Echinoderm bioassay results are summarized in **Table 4.8**. Station DUD206 was the only station to exceed SMS biological criteria.

Table 4.8 BIOASSAY RESULTS AND SMS INTERPRETATION

Station ID	Reference Match	Amphipod Bioassay		20-Day Juvenile Polychaete		Echinoderm Larval	
		%Mortality (Mean)	SMS Status	Growth Rate (Mean)	SMS Status	%Mort./Abn (Mean)	SMS Status
Test Sediment	P9446-2(Ref)						
DUD200	P9446-2(Ref)	13	Pass	0.60	Pass	32.46	Pass
DUD201	P9446-2(Ref)	21	Pass	0.55	Pass	34.55	Pass
DUD202	P9446-2(Ref)	18	Pass	0.62	Pass	34.97	Pass
DUD203	P9446-2(Ref)	22	Pass	0.59	Pass	32.83	Pass
DUD204	P9446-2(Ref)	26*	>SQS	0.51	Pass	16.63	Pass
DUD205	P9446-2(Ref)	19	Pass	0.54	Pass	15.88	Pass
DUD206	Control B	4	Pass	0.52*	>SQS	34.17*	>SQS
Controls:							
P9446-1(Ref)		6[b]		0.48[d]		27.06[f]	
P9446-2(Ref)		8[b]		0.60[d]		29.04	
Control A		3[a]		0.82[c]		30.96	
Control B		1[a]		0.77[c]		15.24	
Seawater						11.82[e]	

Footnotes:
[a] Control sample passes performance criteria of <10% mortality